WATER WORKS & SEWERAGE

A GILLETTE ABP ABC PUBLICATION

EDITOR

JANUARY, 1938
VOLUME 85, No. 1

ockport NEW YORK

The City of Lockport, the County Seat of Niagara County, owes its origin, development and supremacy to its geological and geographical locations and the quality of its environment. The city is situated at a point where a high ridge forms a geological obstruction in the course of the Erie Canal causing a drop of 235 feet between the Erie and Ontario levels. Occupying a Key Position in the expansive area of the Niagara Frontier, the advantages of Lockport's location and her environment are closely interlinked. Sweeping away from the city in all directions is an agricultural district whose productiveness has established for it an international fame, as "The $10,000,000 Fruit Belt."

Lockport is essentially a manufacturing city and is the home of numerous industries whose products command the highest respect and which have a nation-wide distribution.

Lockport's new Filtration Plant, installed at a cost of $550,000, supplies the city with a bounteous flow of crystalline, pure water and has had a most beneficial effect on the health and vitality of the community. From the Niagara River at a point near LaSalle, a distance of 13 miles, the water is piped through thirty-inch steel force mains to the Filtration Plant which has a capacity of 12,000,000 gallons per twenty-four hours.

With its system 100% metered, Lockport is another city where the accuracy and reliability of Pittsburgh Meters is relied upon to measure its water supply.

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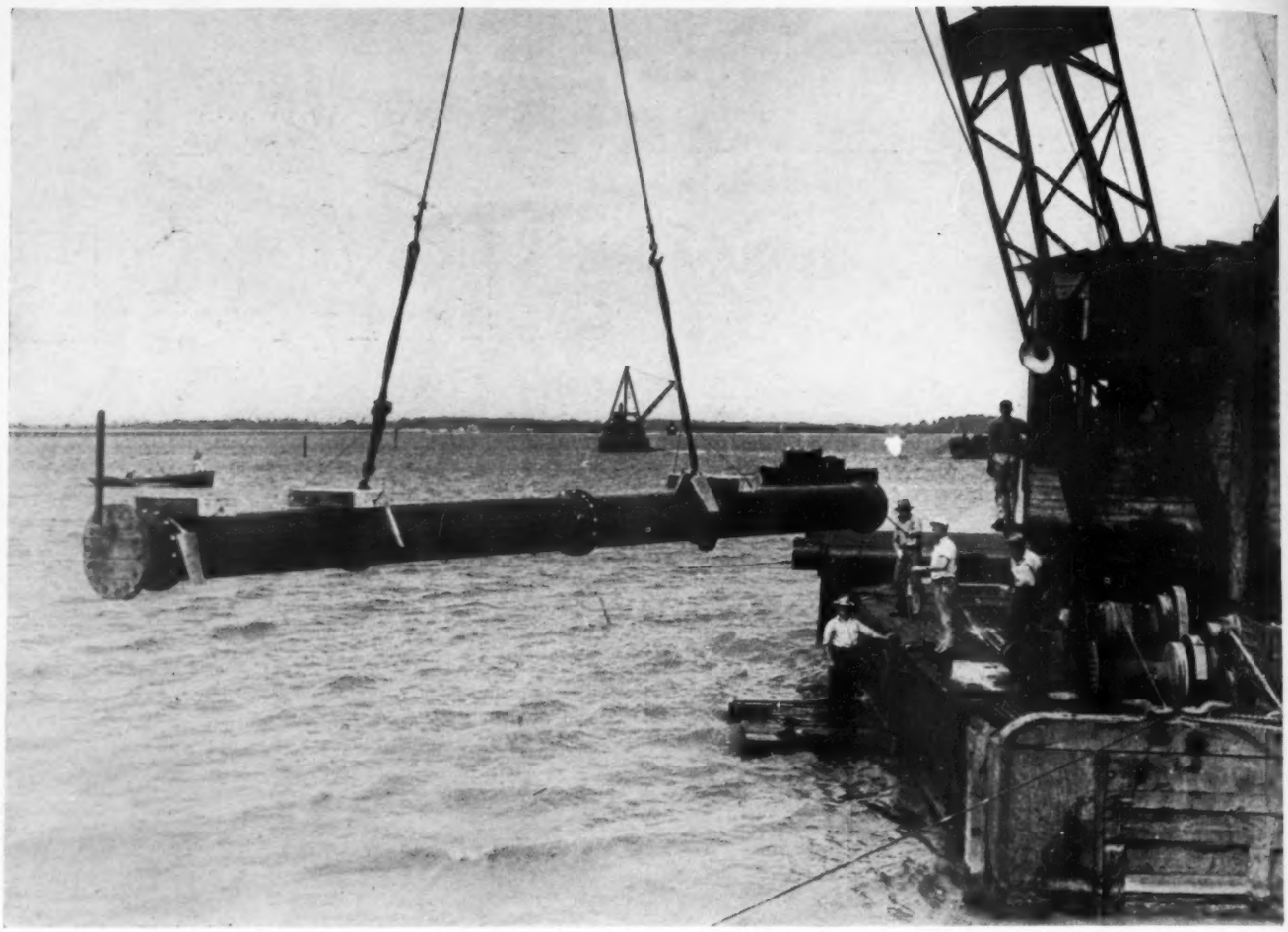

Installing cast iron pressure sewer at Cambridge, Md.

For use in sewerage construction the ratio of cast iron pipe to other materials increases each year. Three outstanding virtues of cast iron pipe account for this: structural strength, infiltration-proof joints and effective resistance to corrosion. A cast iron sewer is a permanent structure. Per year of service it is a money-saving structure. From our strategically located plants and store yards we are prepared to make quick delivery of pipe and standard fittings. U. S. pit cast pipe is available in diameters up to 84-inch; U. S. Super-de Lavaud Pipe, centrifugally cast in a metal mold *without chill,* is produced in 24-inch diameter and under.

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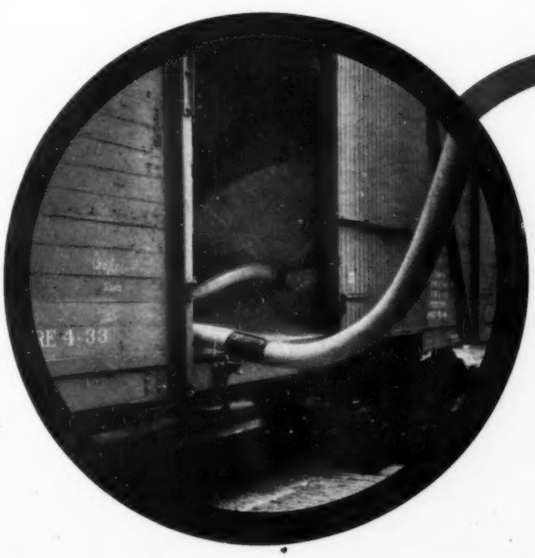

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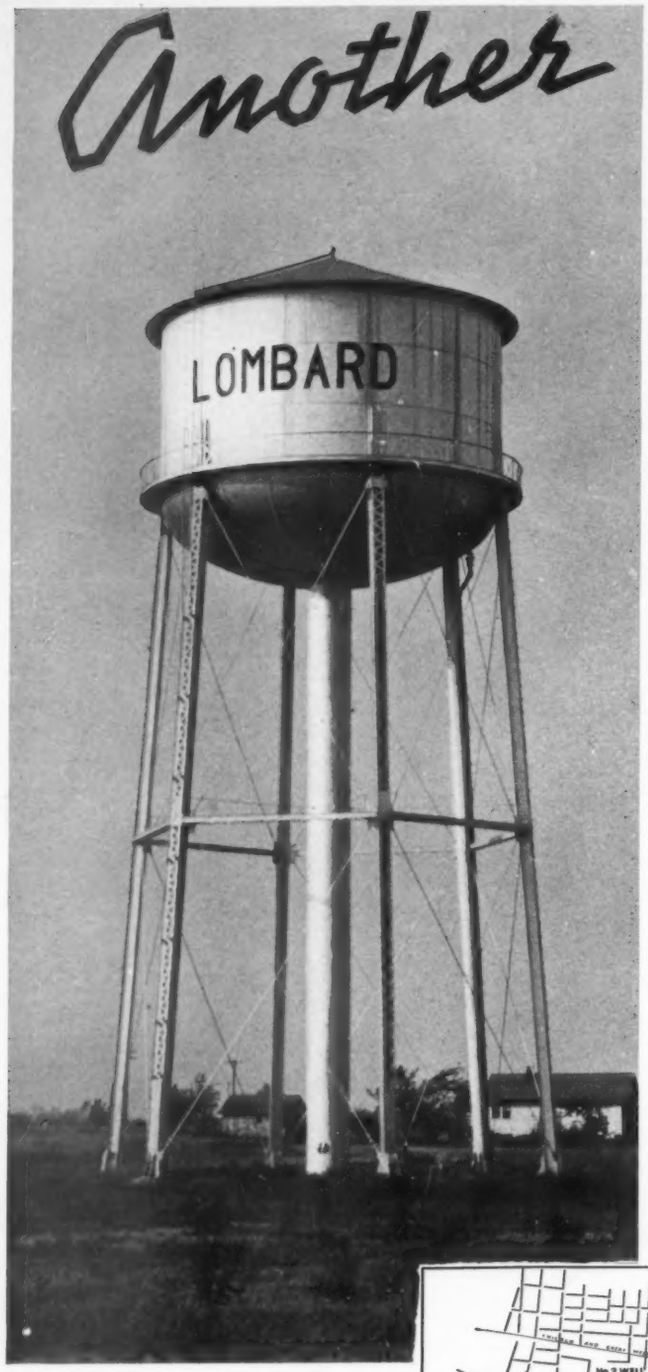


This new 250,000-gal. elevated storage tank at Lombard, Ill., is 68 ft. to bottom. The capacity is equivalent to approximately 25 gallons per capita—sufficient to maintain service for a number of hours in the event of a pumping interruption.

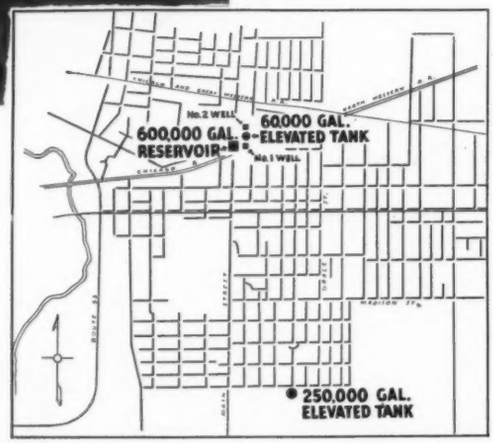
ELEVATED WATER TANK *for Lombard, Ill.*

LOMBARD, Illinois, is another fast growing community that has taken advantage of the lower pumping costs and more uniform water pressures that it is possible to obtain in water works systems through the use of properly designed elevated storage tanks.

The water supply at Lombard consits of two wells; one 2038 feet deep, the other a shallow well approximately 80 feet deep. Water is pumped directly into the distribution system by means of electrically-driven centrifugal pumps.

Previous to 1937, all pumping operations were equalized by a 60,000 gal. elevated storage tank. The 250,000 gal. elevated storage tank shown at the left was added to the system at that time to provide (1) more uniform pumping operations; (2) better water pressures throughout the town; and (3) to maintain service to customers in the event of any interruptions of the power supply or failure of pumping equipment.

This is another example of the many ways in which elevated storage is helping to solve water supply problems. For full information and quotations on tanks, address our nearest office.



The map at the left gives a general indication of the territory served by the Lombard waterworks system. The new tank is located on the southern edge of the town.

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Dallas.....1479 Liberty Bank Bldg.
Birmingham....1586 North 50th St.
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Houston.....2919 Main St.
Detroit.....1551 Lafayette Bldg.
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Boston.1548 Consolidated Gas Bldg.
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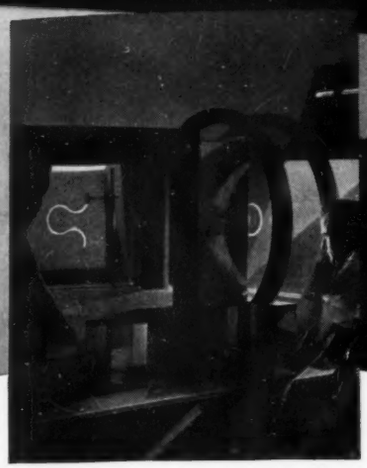
Los Angeles...1455 Wm. Fox Bldg.

IT'S WHAT'S INSIDE THAT COUNTS!



"X-RAYING" THE GOODNESS OF DESIGN

Before the design of a valve body is approved, the photo-elastic test pictured above is made on a plastic model in order to determine visually and accurately where and how stresses will make themselves felt all the way through the valve. Crane engineers don't merely *hope* that Crane valves will stand up—they *know* they will.

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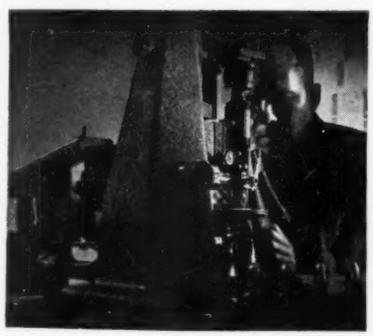

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Before any metal can be accepted for use in Crane valves, it must be approved by the metallurgical laboratory. Test samples from every shipment of raw material as received are subjected to precise metallurgical scrutiny. Thus Crane goodness is assured from the outset—and at every step in their manufacture, the quality of Crane valves is guarded by the laboratory technician.

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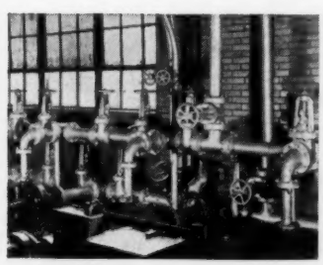

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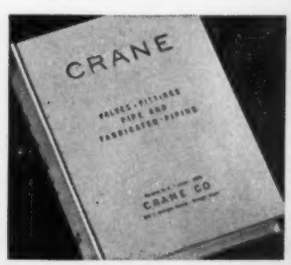
For three generations of actual service, Crane valves have been proving that they are good all the way through in millions of locations. Only Crane has so vast an accumulated experience in producing valves of known quality, of predictable performance in service.



If you want uncommon quality in valves of common use, look in the Crane No. 52 Catalog. In its 764 pages there are 38,000 piping items. Quick delivery is assured from a nearby stock. You will find Crane service, like Crane products, good all the way through.

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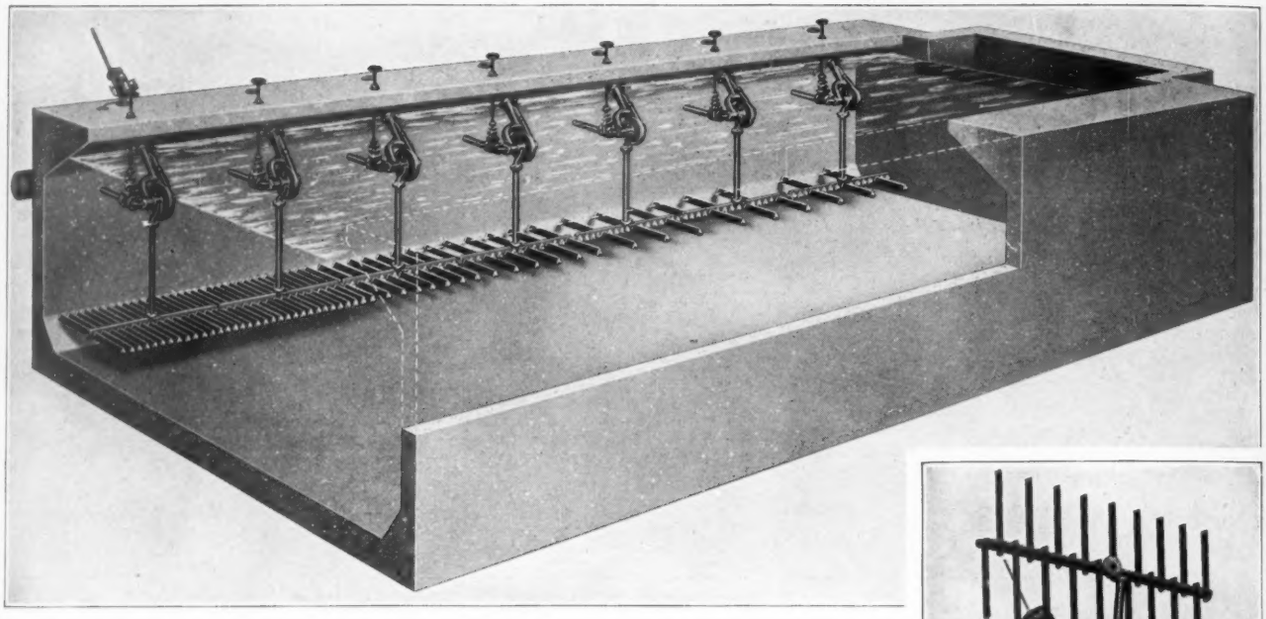


Fig. 2900—Aeration tank with Swing Diffusers. Variable spacing of tubes tapers aeration to minimum at outlet.

Controlled Aeration

for the

Activated Sludge Process

ACCESSIBILITY—Diffuser tubes swing to tank walk by portable electric hoist.

Tube cleaning without dewatering tank or interrupting operation.

POWER ECONOMY—Shorter aeration periods and less air with Tapered Aeration.

Higher aeration efficiency.

Suspension of diffuser tubes lessens hydrostatic head.

Ask for Bulletin 175

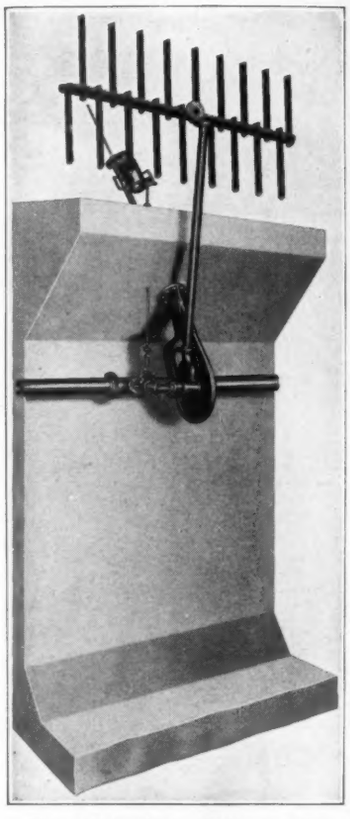
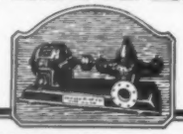


Fig. 2910—Swing Diffuser with tube assembly swung to tank walk. Portable electric hoist in position.

SEWAGE EQUIPMENT DIVISION

CHICAGO PUMP COMPANY



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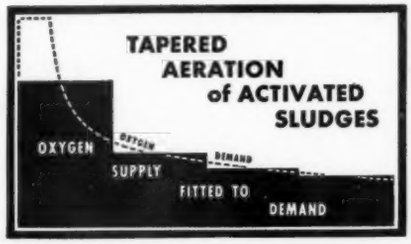

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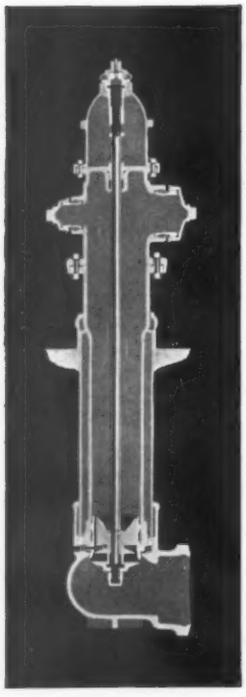

● Fires multiply in cold snaps. People push their furnaces, light faulty fireplaces, start up rusty stoves. Fires are worse in cold weather. Firemen are hampered by ice and snow, winds are high, houses are dry.

Don't let cold weather touch your water supply. See that your hydrants won't freeze underground, that working parts aren't frozen shut. Above all be sure that frost can't heave the entire hydrant away from its main.

Specify Mathews hydrants. They are unique in that frost can't heave them. Their barrel is not in contact with the earth. It is sheathed in a loose protection case which is free to heave without straining any water carrying parts.

Study this design. It is important in keeping fire protection intact and in preventing costly repairs. Mathews is also drained positively and automatically, which prevents ice below ground. Its operating threads are sealed away from internal and external water.

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WATER WORKS & SEWERAGE

E. S. GILLETTE, Publisher — L. H. ENSLOW, Editor

ARTICLES AND AUTHORS Scheduled for Future Issues

"Progress of the Year in Sewerage and Sewage Treatment"—which comprises an annual review of developments in sewerage practices as a feature of our February issue each year, is the production of **E. T. Killam** for our next issue. The author is one of America's youngest and most brilliant consulting engineers, who within the year hung up his shingle and began operating under his own name. Mr. Killam is possibly best known for his excellent work as chairman of the Committee on Pipe Line Coefficients which produced the valuable report on this subject, published in the Journal of the New England Water Works Association. He has been a frequent contributor to the pages of "Water Works and Sewerage," and those who have seen his articles will look forward to his review of sewerage developments and trends in next month's issue.

"A New Development in Water Softening" as recounted by **Charles H. Spaulding,** Superintendent of Water at Springfield, Ill., is descriptive of an innovation in softening procedures and plant design developed by the author, and incorporated in Springfield's new water treatment plant. The novel Springfield Precipitators and their unique functions are described, their performance revealed. Basically, the Precipitators operate on the principle that rolling snowballs gather more snow. Likewise, precipitated granules of calcium carbonate will gather more carbonate, and magnesia more magnesia, when rolling through lime dosed hard water. In up flow tanks the accumulating blankets of precipitates (in motion) serve as "scrubbers" to remove colloidal carbonate and hydrate by the plating out process, in which Spaulding's little "snow-balls" become bigger ones. The net result is an automatically balanced water reaching the filters—one with the minimum of residual hardness and encrusting qualities, produced with economies in lime requirement, elimination of recarbonation, double rate filtration. Here is a story which might be captioned "The Evolution of a Laboratory Control Procedure into Plant Practice," for that is what Mr. Spaulding's intriguing scheme represents in the last analysis.

"Contact Aeration in Bio-Flocculation of Sewages"—by **E. W. Steel,** Professor of Sanitary Engineering, State College, Texas, relates the results of development work on an economical method of sewage treatment, involving the adaptation of air-diffusion upwards through tanks filled with multiple plates for contact surfaces. Developed at Waco, Texas, by Clyde C. Hays, City Chemist, the process has been tested elsewhere and is now reported on by Professor Steel. In brief, the scheme involves de-colloidization by a combined mechanical and biological adsorption (plating out) process on vertical surfaces of large total area, subject to periodic film sloughing. The air consumed is only sufficient to maintain aerobic conditions and a healthy film—simulating the trickling filter, or the "Tank Filter" of Imhoff and Bach, recently described in this magazine. In view of the growing interest in economical bio-flocculation methods, Professor Steel's article is especially timely and contains much of basic interest.

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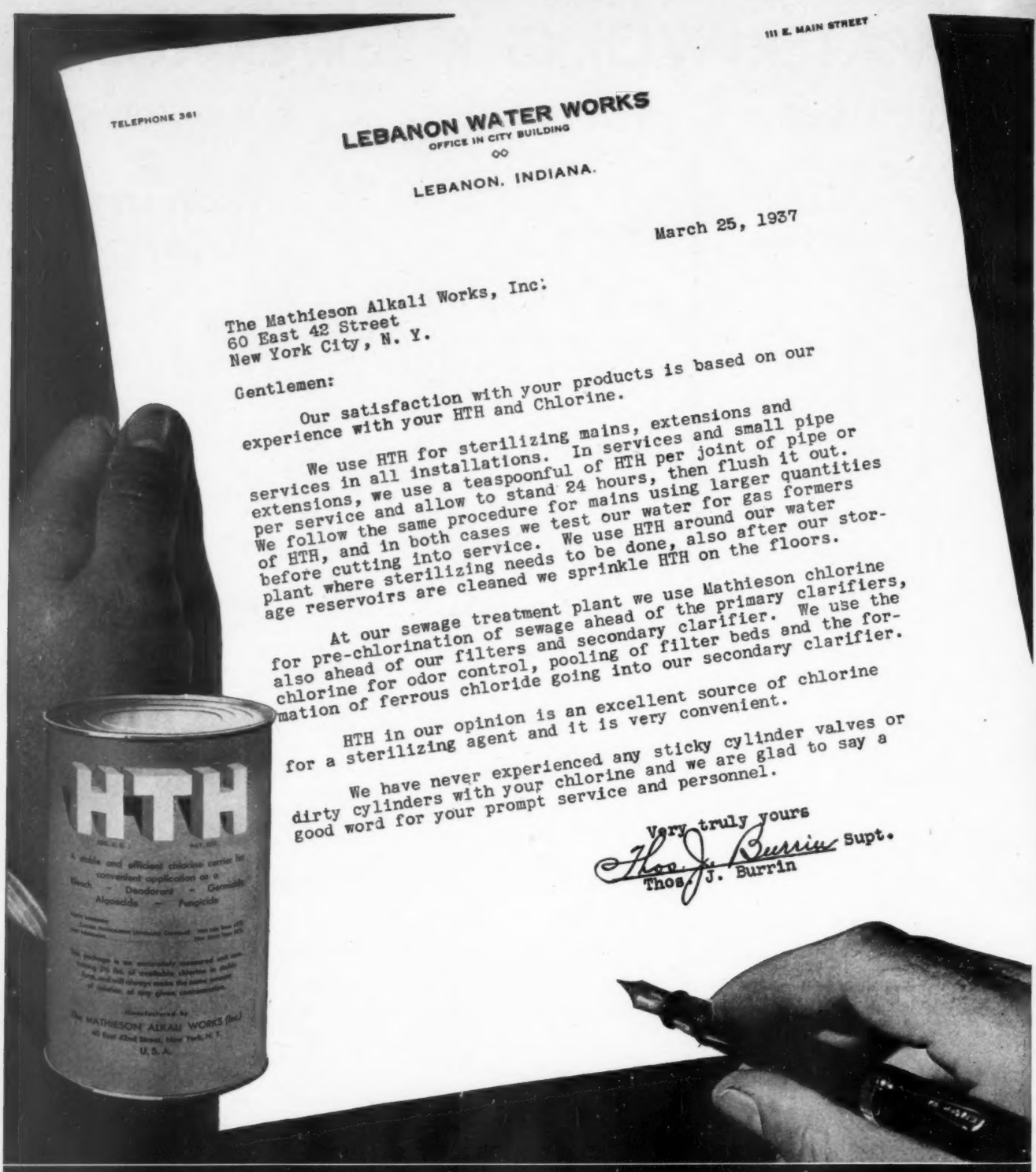
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WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. 85 JANUARY, 1938 No. 1

PROGRESS AND TRENDS IN WATER WORKS DURING 1937

By L. R. HOWSON*
Chicago, Ill.

The Author

IT IS impossible to record in one brief review all of the developments in water works during the year; likewise it is impossible in most cases to segregate the developments of a particular year from those evolutionary changes which require a longer time for their maturity; however, it is practicable to indicate trends and in some instances to record individual items of progress and to illustrate both from practical applications in the water works field.

While the supplying of water is our oldest utility service the industry is far from static. One has but to compare practice of twenty-five years ago with that of today to forcibly demonstrate how great the changes have been. To illustrate; the turbo-centrifugal and motor driven centrifugal have supplanted the vertical triple expansion and horizontal cross compound pumps in new installations; 85 per cent of the filter plants in the United States have been built in that twenty-five year period; copper services, now so largely used, were unknown twenty-five years ago; chlorination was in its infancy; reinforced concrete was just coming into use for filter plant construction; taste and odor control, although sorely needed, was unheard of; water softening was practiced at only one or two plants, and recarbonation has been developed only in recent years; these and many other developments have taken place to deliver to the urban population in America a more abundant supply of water of greater purity, more palatable, and more pleasing generally to consumers. Progress in all lines continues.

Among the outstanding experiences of the year were the Ohio river flood; the construction of two municipally operated industrial water supply projects; research on coagulation, prevention of corrosion and control of tastes and odors; new departures in large elevated tank design; construction of large steel and concrete pipe lines and the greater use of automatic valves; and, the completion of a large number of projects, large and small, financed in most instances through Federal aid.

*Alvord, Burdick & Howson, Engineers.

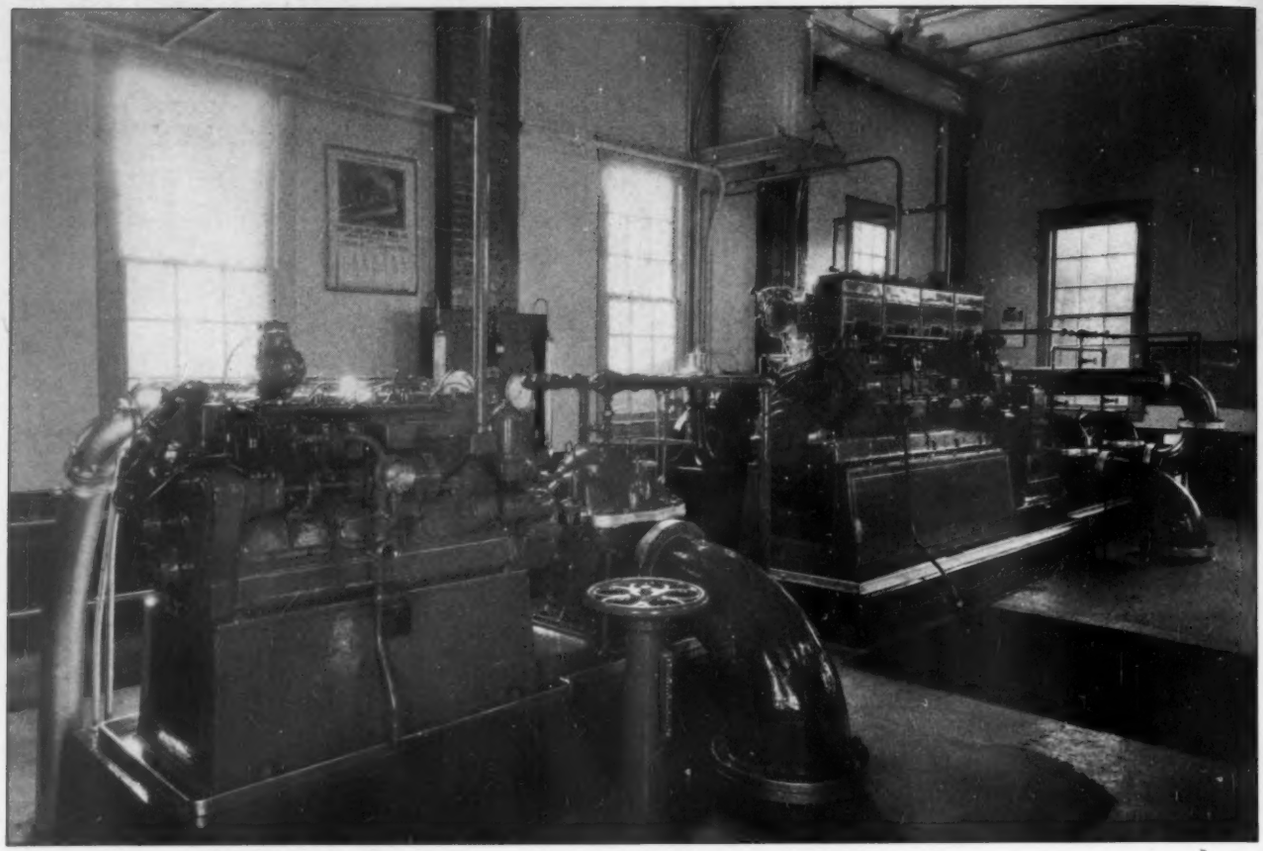
Effects of Ohio Flood on Water Works Operations

The month of January, 1937, witnessed the greatest flood experienced in the Ohio Valley since its occupancy by white men. The entire reach of the river from Cairo upstream to Wheeling had flood heights not previously recorded and taken in conjunction with the Pittsburgh flood on the upper Ohio in the early part of 1936 a complete new flood profile was established from headwaters to the Mississippi. In this reach every important water works, with the exception of Ashland, Ky., was required to suspend operations. Over 1,500,000 people in over 100 communities were without water service for periods varying from a few days to several weeks—a dramatic illustration that water supply is a "service" rather than a "commodity."

In fairness to the water works designers, it must be stated that practically all major plants, at least, had a prior record of fifty years or more of uninterrupted service, only broken in 1937 by a flood whose crest was as much as ten feet above any previously of record in a 175 year period.

The occurrence of such a flood brought to light new lessons which should serve to minimize the effect of recurring floods. In most cases it appears, from post-flood studies, that it is cheaper to protect water works structures against flood than to allow the structures to flood and supply the water required during the flood period from storage. This is particularly true on large rivers where the flood crest extends over a considerable period.

Growing out of the experience of January, 1937, a number of cities have already taken definite steps to prevent the recurrence of conditions which then prevailed. At Evansville, Ind., the protection is being provided by an earth enclosure which in effect places the pumping station and filtration plant on an island during extreme flood stage. This enclosure will be 6 ft. above the 1937 flood crest. At Louisville plans have been made and bids are to be received shortly on pumping equipment of the deep well type, installed in the wet well of one of the river pumping stations, with motors set well above any flood height. Cincinnati is likewise getting prepared for floods in excess of the record 1937 flood. Nor is protection of this kind being confined to Ohio river cities. Quincy, Ill., on the Mississippi, is at the present time protecting its station against floods which



75 H.P. and 450 H.P. Gasoline Engines Recently Installed in the Clarksburg, W. Va., Pumping Station.

have not yet occurred. In this connection, it is important to point out that the best time to protect against a flood is before it occurs. Following the example of Quincy, undoubtedly many other cities could well take such steps in the direction of preparedness.

Pumps

Specifications are now out to bidders for proposals on the largest self-contained motor driven vertical pumping units of the deep well type thus far built. These units, four in number, each of 15 million gallons daily capacity against 200 ft. head, are designed for use at Louisville in connection with provisions which are being made to insure continuity of water service during a repetition of flood conditions comparable to those which existed in 1937.

While there are many installations of motor driven deep well equipment of the turbine type in capacities up to 2 to 5 million gallons per day these four units are believed to be the largest of that type yet built. They will have a vertical shaft extending from the pump to the motor, a distance of approximately 71 ft. The pumps themselves will be about 24 inches in diameter, and will have 700 H.P. synchronous motors.* The estimated cost of the four units installed, including piping and electrical connections, is $125,000, the equivalent of about $2,000 per million gallons capacity. This seems like a small amount to pay for insurance against floods interrupting water service to 370,000 people, particularly when compared to the $3,000,000 investment in the present low lift stations and the $28,000,000 value of the entire water works system. At Louisville it would cost approximately $500,000 to provide reservoir capacity sufficient to store but one day's requirements.

The novel "Submersible" deep well turbine pump, previously employed on industrial supplies, has come into the domestic water supply field. The motor is close coupled *beneath* the pump bowls, and the motor-pump unit hangs submerged on the end of its shaftless riser pipe.

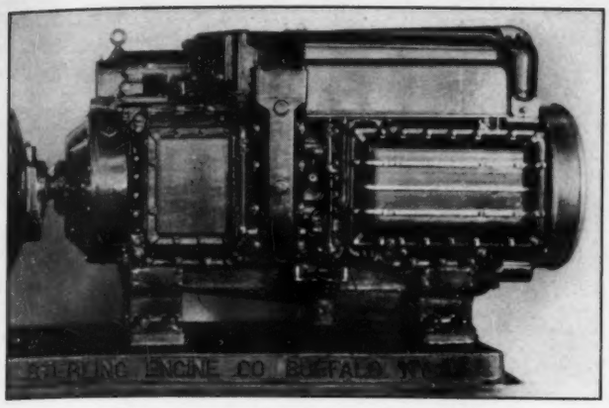
Chicago's recently completed Cermak pumping station set new records for efficiency in electric centrifugal pumping equipment. The six units, each of 50 M.G.D. against 136 ft. head and equipped with 1500 H.P. synchronous motors, developed overall (wire-to-water) efficiencies of from 88.56 to 89.15 per cent.

Chicago is an excellent illustration of diversification in its pumping equipment. It has six steam and four electric stations with 63 per cent of its capacity in steam and 37 per cent electric. Continuity of service is assured even in case of an exceedingly rare breakdown in electric service of the type illustrated at the Chicago Avenue Station about ten years ago, and in New York a year ago.

Engines

Prior to the last year, the largest gasoline engines that were available for driving centrifugal pumping equipment for standby service were 300 H.P. Now, the largest manufacturer of this type of equipment has recently developed a unit having a capacity of 450 H.P. A number of these units have already been built and installed. They are capable of operating a centrifugal pump delivering up to 12 million gallons daily against 65 lbs. pressure, thus increasing the adaptability of gasoline engine driven centrifugals for stand-by service in the larger plants. The reliability of this type of equipment for stand-by service has been demonstrated over a period of years.

*[At Spokane, Wash., a recent installation involves two deep well turbines with 24 inch bowls, 900 H.P. motors, delivery of 12 M.G.D. against a 400 ft. head—the largest deep well units to date.—ED.]



Sterling's Novel Crankless Diesel.

The same manufacturer has also developed during the past year a low cost, light weight, crankless Diesel engine. The engine, with a speed range of from 400 to 1200 r.p.m., is thereby well adapted for direct connection to the pumps. The engine is an opposed piston engine with four horizontal cylinders containing eight pistons (four on one side coming to the center to meet the four on the opposite side). This results in the complete elimination of cylinder heads and poppet valves. The engine has high thermal efficiencies and is easy to start. The cost of this engine (about $40 per H.P.) is approximately half that of the conventional style Diesel engine.

Two other manufacturers of standard Diesels have improved their designs by reducing weight and cost. The new models weigh from 125 to 160 lbs. per H.P. and cost from $60 to $75 per H.P. They operate at from 400 to 600 r.p.m. and with fuel requirements of from 0.4 to 0.5 lbs. per H.P. hour.

While it may be too early to predict the extent to which these lighter diesel engines will be of service in water works, as compared to the more widely known gasoline engine of the marine type, they would seem to have advantages that will make them popular, and are of interest for more than purely stand-by requirements.

The flood of 1937 in the Ohio Valley served to emphasize the necessity of having reliable auxiliary pumping equipment, particularly in those plants that were pumping by electricity brought in from an outside source. The development of larger and more economical equipment adapted to auxiliary service is, therefore, of especial interest to water works operators.

Filter Plant Design Features

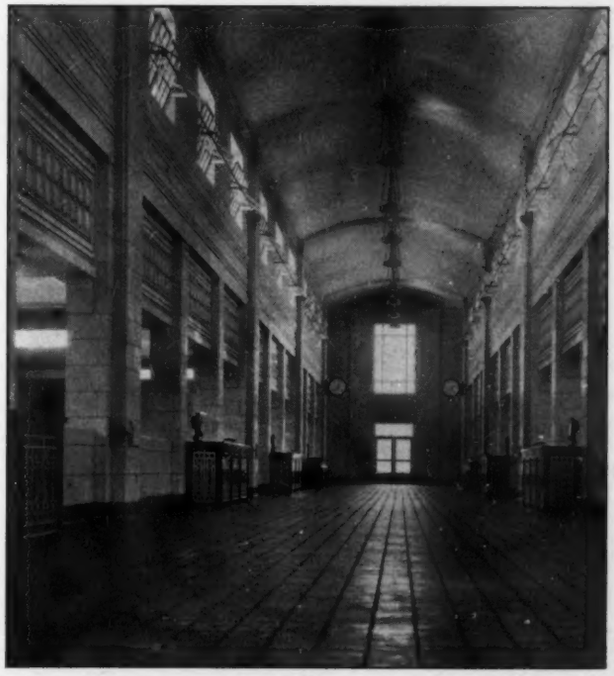
That water treatment is not a static art has been attested to in recent years by such novel illustrations as the Morse all steel plant at Burnt Mills, Md., and the perpendicular design at Lexington, Va., the use of two-story coagulation basins at Milwaukee and elsewhere, and the use of surface filter-wash at a number of places in the Great Lakes region.

This year witnesses a novel treatment plant constructed at St. Petersburg, Fla. The type of construction was dictated quite largely by the hydraulic requirements of the plant in which the flow line was slightly over 20 ft. above the ground. Design studies indicated steel to be the most economical material available for construction. The plant, accordingly, consists of a series of steel tanks serving as the aerators, lime mixing basins and filters. The plant includes an upward flow sedimentation basin in which the incoming water enters *beneath* the heavy sludge blanket and rises through it in up-flow units. The results to date are stated to have demonstrated the efficiency of this unique sedimentation basin design. Sludge removal from the lime precipitation and coagulation tanks is accomplished by reversal of flow. The 20 ft. head available forces sludge into the perforated radial pipe system at the bottom of each tank, when it is open to the drain, the same radial grid serving as the influent distributor in normal operation. No mechanical scrapers are used. Flushing of the lime precipitation tanks requires but a few minutes daily and the coagulation basin but once a week. The cost of the entire installation, with a capacity of 6.66 M.G.D. (operating at a rate of 2.5 gals./sq./ft./min.) was but $134,000, or $20,000 per M.G.D. capacity.

Progress in the so-called conventional type of filter plant design has also not been dormant. Among the innovations which have been introduced in the past year are the following:

(a) In the Milwaukee plant where each filter unit has a capacity of 6.25 M.G.D., and in Denver where the units are 5.6 M.G.D., lighting of the water surface in the filters has been accomplished entirely from skylights in the roof. The walls surrounding the filters have no opening, and resemble garden walls. The skylights vertically above the water surface have a glass area approximately 25 per cent of the water surface. The vertical illumination as contrasted to the usual cross light gives an excellent and pleasing view of the water surface without cross glare.

(b) The prevention of condensation in filter plants has always been a bugbear. Experiments conducted at Evanston, Ill., and elsewhere, indicated the desirability of so designing the heating and ventilating facilities as to result in as little air movement as possible, particularly movement over the surface of the water. In a large plant such as Milwaukee, where there is about 1.5 acres of water surface under the filter building roof, it is apparent that any large movement of air would pick up a lot of moisture which would result in subsequent condensation. In the Milwaukee plant, therefore, as in some others, the design places practically all heat in the operating gallery where it is needed, with radiators so located as to prevent air currents from passing across the filters. The space between the filters and the operating gallery is further restricted by dropping a curtain wall from the ceiling and by a solid parapet wall from the floor about 3.5 ft. in height, leaving a space about 6 ft. in height for observation of the filters. Just enough heat is placed at the back of the filters to keep the building above freezing point. A still further extension of this aim to achieve restricted circulation over the cold water surface is the



Operating Gallery of Denver's New Moffat Filter Plant.—(Note the Curtain and Parapet Walls to Minimize Air Currents over Filter Water Surface—also Skylight Illumination of Water Surface.)

glass partition between the filters and the operating gallery of the Ottawa plant.

Observation of unit heaters in a number of plants, indicate the undesirability of this type of heating in a filter plant with its large water surface. Condensation is at a maximum in unit heater installations.

(c) In an effort to still further reduce the condensation in filter plants, a number of recent plants have covered the entire roof surface with cork. Economic comparisons of heat saving and cost of cork indicates that about 1 inch of cork is the economical thickness in the latitude of the Great Lakes. This installation costs but approximately 15 cents per square foot. The saving in radiation more than justifies the expense. Reduction in condensation troubles is a further advantage.

(d) The installation of floc detectors, by which the presence of finely divided suspended matter is detected in routine operation if it passes through the filters, is becoming standard. In simple form a sample of the effluent, in a glass container in a dark box, is illuminated by a light beam in such a manner to magnify the floc; the cost of this type is but approximately $50 each. A more expensive form, on the principle of the electric eye, installed either with or without an alarm bell can be had for a cost of approximately $250 per unit.

Greater attention continues to be paid to the question of the pretreatment of water. Practically all filtration plants of important size are being provided with mechanically operated mixing and stirring equipment to improve and economize in coagulation and softening practice. Flocculators are coming into general use. With the use of equipment of this kind the turbidity of water going to the filters is being reduced, and the uniformity of the finished product is materially improved. In many instances operating costs have also been reduced.

The use of filter sand of coarser size than formerly specified is now general practice. This, like other improvements, probably goes hand in hand and as a result of better pretreatment of the water. Effective size of 0.45 to 0.55 m.m., by the Hazen method, is now the rule.

The experiments of Baylis at Chicago with respect to surface wash and the pioneer installations of perforated pipe grids at Kenosha and Racine have served to show that for Great Lakes waters surface wash performs a real function. The new Milwaukee plant and others in-

The Unique All-Steel Water Treatment Plant of the Pinellas Water Co., St. Peterburg, Fla.

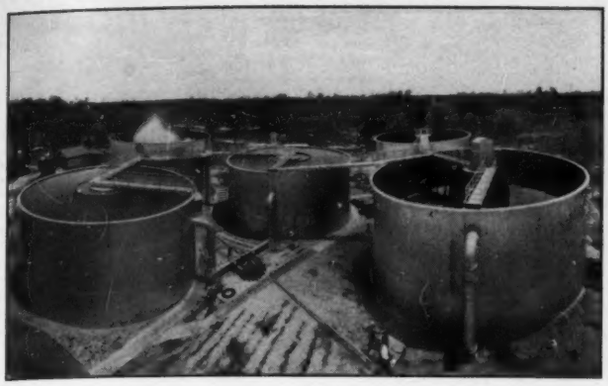
One midwestern plant received numerous complaints of inky black water during a cold period. Investigation showed the trouble to be due to powdered carbon that had passed through the filters at times of weak coagulation. The installation of floc detectors on each filter has enabled the operator to check his filter performance and prevent recurrences.

(e) Filter plant operators have always had difficulty in knowing the opening rate and position of hydraulic valves. In recent installations indicators either of a strip type, in which a continuous graduated strip passing over an illuminated wheel indicates the position of valve opening, or a more recent development of an electrical resistance method of indicating the same thing, are now being installed in most new plants. This indicator materially reduces the likelihood of opening the wash water valve too fast and overturning the filter beds. Also of closing valves too rapidly and creating water hammer.

(f) Chemical feeding equipment on the larger plants is now more prevalently of the gravimetric type, in which the feeding of the chemicals is determined by weight rather than by volume. Equipment of this type controlled by precision type scales, and other refinements, will feed at a guaranteed accuracy of from 1 to 3 per cent on any dry material.

clude surface wash. In the ordinary installation the cost averages approximately $500 per million gallons of filter capacity. During the year an installation was made on four filters in an Ohio river plant where there was continual difficulty with mud balls. The results have been astonishingly good, indicating the desirability of surface wash (sand scour) for other plants with similar experiences. Where water for surface wash is taken from the mains at 50 lbs., or more, pressure the usual installation in beds of moderate size (1 M.G.D.) consists of 1 in. to 2 in. piping spaced at 30 to 40 inch centers with 3/16 in. to ¼ in. holes drilled on the horizontal axis at 8 in. centers. The pipes are installed about 1 inch above the sand level when filtering but are below the sand level when it is expanded in washing.

Mud balls and the cracking of filter beds have always given the operator considerable concern. However, until the work of Baylis (first reported in WATER WORKS AND SEWERAGE in September, 1935) was available, there was no method of evaluating the effect of mud balls or



Cluster of Steel Tanks Comprising the St. Petersburg, Fla., Treatment Plant.— (Left) Lime Precipitation Units with Aerator and Clear Water Storage Beyond Filter Tanks.

of classifying filters with respect to the percentage of mud balls present. Baylis further elaborated upon this method of measurement in the July, 1937, Journal of the American Water Works Association. Briefly, Baylis' method consists of collecting samples from the top 6 inches of the filter beds. The sampling device is made of a thin copper tube about 3 in. inside diameter and 6 in. long, the volume of which has been accurately determined before using. In collecting the sample the filter is washed and the water drawn down 12 or more inches below the surface of the sand. The sampler is then pushed down 6 in. into the bed and lifted full of sand. The sand collected in this way is separated from the mud balls by means of a ten mesh sieve by placing portions of the sand in the sieve and gently raising and lowering the sieve about a half of an inch at a time under water until all of the free sand is washed through and the mud balls remain. The volume of the mud balls is then determined by displacement of water in a cylinder graduate. Baylis classified filter beds tested according to this method as follows:

Per cent Volume of Mud Balls	*Condition of Filtering Materials*
.0— .1	Excellent
.1— .2	Very good
.2— .5	Good
.5—1.0	Fair
1.0—2.5	Fairly bad
2.5—5.0	Bad
Over 5%	Very bad

Following the Baylis method, the State Department of Public Health of Illinois collected data on 40 rapid sand filter plants within the State of Illinois. The results of this study were reported by Mr. P. W. Klassen, State Sanitary Engineer, at the Buffalo Convention of the American Water Works Association. Data from these 40 plants show a definite relation between the appearance of the filters, and the condition as indicated by the mud ball test. Filters with a low mud ball rating showed no cracking or drawing away at the surface. Good coagulation was reflected by good filter sand condition, whereas, the reverse was true where inefficient coagulation and sedimentation were provided. The study also showed that the filters were in uniformly good condition where the wash water rates exceeded 15 gals. per sq. ft. per minute. Another conclusion drawn from this study was that pre-chlorination had proved effective in correcting for deficiencies in coagulation or washing.

There can be no question that distinct advancement is recorded when direct observation is supplemented by analytical methods of evaluating the extent of deficiencies. This is illustrated by the development of the threshold number of evaluating the intensity of tastes and odors by Baylis and Spaulding, and by this method of evaluating the cleanliness of the sand beds, and the factors affecting and resulting from that condition. The alert operator will classify his filters, and if in bad condition ascertain the reasons therefor, and take steps to improve their condition.

In the Chicago Experimental Filter Plant a method has also been developed for rating filter-bed or flocculation deficiencies by continuous filtration of a very minor flow of filter effluent through a disc of absorbent cotton. The sediment in the filter disc reveals the relative filter efficiencies, in respect to bed leakage of floc particles and other suspended matter.

At Allentown, Pa., Krum and Jones developed an interesting sand bed expansion indicator. It is described in their article (WATER WORKS AND SEWERAGE, Oct., 1937) and reported to be accurate, economical and most helpful in securing efficient filter wash by operators otherwise depending too greatly on personal judgment in this important operation.

Service to the Profession

Too much credit cannot be given to the agencies which conduct experimental laboratories. An outstanding illustration is the million gallon experimental water filtration plant which has been operated for the past ten years by the City of Chicago under the direction of John R. Baylis.* When one considers the progress that this laboratory has either developed or participated in, such reflects not alone the personal capacities of the men in charge of that work, but is also a tribute to the community which sees the importance of such research work and makes the expenditures necessary for it. It is by work such as this that the water works profession has been able to make well defined progress and advancement in improving the quality of supplies from the standpoint of chemical characteristics, palatability and other features during the past few years, to exceed that previously made in all time.

Water Quality

In the field of water treatment during 1937 greatest attention was given to means of improving the pretreatment of the water, to studying the factors affecting corrosion and means of its prevention or correction, and to the turning out of a better tasting, more palatable water.

Baylis, reporting his findings in this magazine during the year, continued his studies relative to the effect of compounds of silicon, either as naturally present in the water or by its addition in certain forms, to aid coagulation. This development, while it has not progressed to the state where assurance may be had as to the extent to which it will be useful in water treatment, has progressed to the point where it is probable that many filtration plants would find it sufficiently helpful to justify the cost of its use where the water is hard to coagulate. Developments in this important field have been excellently set forth by Baylis in WATER WORKS AND SEWERAGE in a series of articles on "Coagulation" December, 1936, et seq.

The presence of fluorides in water, which is largely a recent source of worry to the water works field, received more attention during the past year. The Ohio

[*To Arthur E. Gorman, Chicago's Engineer of Water Treatment, goes much credit for having persuaded Chicago Water Bureau heads to establish the Experimental Filter Plant and in securing John R. Baylis, as Chemist in Charge. To Loran D. Gayton, Chicago's City Engineer, appreciation for the free use of information, data, and design which has come out of the Experimental Plant.—ED.]

State Department of Health, and others investigating the subject, have found that with waters high in magnesium or waters to which magnesium sulphate has been added some considerable removal of fluorides can be effected when the magnesium is precipitated with lime. With further attention, which the subject is now receiving by state authorities, by National Aluminate Corporation and, possibly, other commercial groups, it seems probable that shortly a practical and not too costly means of removing this latest undesirable element from waters will be developed. "Defluorite" is being offered as a commercial material for removing fluoride in a manner similar to zeolite softening.

The study of corrosion in distribution systems, house fixtures and piping is receiving renewed and extended attention. Its importance cannot be too well emphasized. In the ordinary water works system approximately three-quarters of the value is in the distribution system. This is equivalent to some $30 per capita more or less. The household plumbing and fixtures probably amount to several times this amount, so that the total dollar value of the water works facilities affected by corrosion probably varies from $100 to $200 per capita.

During the past year Hoover at Columbus has conducted a series of experiments which at least tend to throw considerable amount of light upon this perplexing subject. Hoover's investigations showed the fallacies in some generally accepted beliefs of the relation between pH values and corrosion, etc. The Columbus studies are still in progress. While the answer to the question of corrosion control may not be as yet determined, and while each problem may be to an extent a unit unto itself, the subject is one of such importance to every community that every water superintendent should be attempting to find out the facts relative to his own particular situation. Corrosion and tuberculation are too costly to be allowed to go incompletely solved. Certainly progress has been made when an investigation such as that underway at Columbus introduces some questioning of the generally accepted theories on such an important item. Manager, engineers and chemists should look more deeply into the efficacy and accomplishments of chemical treatment.

During the year two granular carbon filter plants went into operation at Oshkosh and at Neenah, Wisconsin. The Oshkosh plant (4 M.G.D.) consists of granular carbon filters in series with the previously built sand filters. At Neenah, where a ground water supply had formerly served the city, it was decided to install a combined filtration and softening plant using Lake Winnebago water and to install, as a final step, granular carbon filters of 2 M.G.D. capacity. Both Neenah and Oshkosh installations, for reasons of economy, use powdered carbon to do most of the work ahead of and within the sand filters. The granular carbon filters are installed in both cases simply for the added protection and insurance against any tastes and odors getting by the plant and to the consumers. So long as the cost of granular carbon is maintained at two to three times that of powdered carbon its extended use in the water works field (so desirable) is likely to be restricted.

The quality of public water supplies, as measured by their palatability, has continued to improve during the year. It is reasonably safe to state that almost any water supply, particularly in a community which has a filtration plant, can be delivered to the public substantially free from tastes and odors at all times and under all conditions. Experience has, however, proven that this can only be accomplished by everlasting vigilance. Daily, or more frequent, determinations of threshold numbers and other indices should be considered an essential part of filtration plant routine. The water works operator cannot be responsible for tastes and odors coming to his plant but if they reach the consumers it is, in most cases, to be considered his responsibility.

More is being heard, and favorably so, of ammonia-chlorine treatment to maintain non-tasting residual chlorine to the ends of distribution systems for the purpose of minimizing bacterial aftergrowths. Corrosion (red water) and degradation of waters in dead ends and other sluggish flow sections, with consequent taste, odor, and "black water" troubles, has been reported materially lessened by this biological control expedient, if not completely controlled. Much is heard of cross connection hazards later touched upon in this review. Pending needed corrections and eliminations, the matter of carrying residual chlorine through to the consumers' taps has an additional factor in its favor.

Dam Construction

The past year has witnessed the completion of many large impounding reservoir projects, which are illustrative of the advancement which has been made in recent years in the construction of earth and rock fill dams. This type continues to be the most frequently adopted type of dam so far as water supply is concerned.

Earth and rock fill dam construction, until recently, generally followed empirical practice. In recent construction, this practice has been expressed in terms of scientific control. This statement applies particularly to the selection and grading of materials, the controlling of moisture in the fill, and the development of means for testing accurately the compacting which is being effected to prevent infiltration through or around the fill.

Some of the largest water works dams yet built have been constructed in the past year or two, including the 185 ft. earth dam as constructed by the Denver Water Board, the 115 ft. earth dam at Little Rock, the San Gabriel Dams at Los Angeles, and others at Fort Smith, Colorado Springs and elsewhere, and while not devoted to water supply purposes, there are, of course, the Fort Peck and Grand Coulee Dams which are monuments of construction of this type.

The magnitude of recent earth dam construction, together with general progress in reducing costs of construction, has led to the development of much special machinery adapted to construction of this kind. Earth dam costruction of today is entirely mechanized, is flexible and due to the enormous quantities which can be handled in a short time, enables greatest advantage to be taken of favorable weather, more remotely located but better adapted borrow pits and the assembly and compacting of properly graded materials into an almost perfect structure. In the well organized present day earth dam project, materials are delivered to the dam in a steady stream of trucks operated at intervals of from 10 to 15 seconds apart, traveling 15 to 20 miles per hour with 6 to 30 cu. yds. of material per trip.

As illustrative of progress in this type of construction, at Denver the 185 ft. Ralston Dam is now nearing completion. This dam has a bottom width of 945 ft. at its greatest section. The middle third of this dam is made of selected clay, sand and gravel built up in 6 inch layers. The moisture content of this material is carefully controlled and is kept within 2 per cent above or below the 16 per cent optimum. Moisture content is determined by the soil testing laboratory maintained on the site. The average dry density for the select core section, as placed to date, is approximately 112 lbs. per cu. ft.

So. California Metropolitan Aqueduct from the Colorado River. Construction of a Part of the Distributing System Involving Precast Concrete Pipes 12 ft. Diameter, Weighing 42 Tons Each—the Largest Known.

The settlement of the San Gabriel rock filled Dam No. 2 focused attention upon the causes of that failure and the difficulties inherent in the construction of dams of that type.

At Colorado Springs there has been constructed a second rock filled dam having a steel upstream face of a type of design peculiar to the Colorado area. The steel face is anchored to the rock or cut-off wall at the sides and a heavy reinforced concrete apron at the bottom of this site. The ¼ inch steel plate is continuous throughout with all joints welded. Expansion is provided by building U-shaped troughs running up and down the slope at about 25 ft. centers. The steel plates are assembled on a light frame work which extends 3 ft. beyond the face of the dam. After the underside of the plates was painted with red lead, the 3 ft. space was filled with gravel. The exterior or exposed face of the plates is painted with gray lead and oil to provide minimum heat absorption.

Pipe Line Construction and Materials

Cast iron continues to be the leading material for use in water works distribution systems. In recent years, particularly in the active water areas, the use of cement lined pipe has increased. The nominal increase in cost, from 6c to 8c per foot for the 6 inch size and from 17c to 21c per foot for 12 inch pipe, justifies its use with active waters such as are found in the eastern, southeastern and northwestern part of the United States and, less frequently, elsewhere. There is a growing appreciation of the fact that in buying pipe what is *really* being purchased is water carrying capacity. On this score materials and coatings are being more critically selected, with particular reference to the local requirements.

Centrifugal or spun pipe is taking an increasingly large proportion of business from the longer established pit-cast type. Some important manufacturers now make nothing but the centrifugal pipe; others make both. It is probable that at the present time 75 to 90 per cent of all pipe is made by processes other than pit casting. Centrifugal or spun pipe is now available in sizes up to 36 inches and in lengths of 12 ft., 16 ft., and 18 ft. In recent years the use of cast iron pipe has been restricted to sizes 36 inch, and below.

Transite pipe, first introduced into the United States in 1930, has made some inroad into cast iron pipe sales. As reported by the Committee of the American Water Works Association (May 1937 Journal) only 549 miles of transite pipe had been laid in the United States in the first six years. However, during 1936 an additional 254 miles was laid, or approximately 50 per cent as much as had been laid in the first six years. While it is too early to tell how far the use of this material will go, its practicability from the standpoint of shipping, strength, reliability and uniformity has been under observation both in active service and by such agencies as the National Board of Fire Underwriters for some time.

The American Water Works Association Committee summarized the Underwriters' conclusions as follows:

"From the conclusions drawn it will be noted: that, it is practical to handle and ship the pipe and couplings and install and maintain them in underground piping systems; that, systems constructed of them are not subject to rapid deterioration; that, the pipe and couplings are capable of withstanding all reasonable stresses to which they are likely to be subjected under ordinary service conditions; that, they are reliable in service; that, they are uniform and can be uniformly assembled."

The use of steel pipe in the larger sizes has been given added impetus. This is largely due to the development of bituminous coatings which give promise of solving to an important degree the corrosion, tuberculation and soil pitting handicap, which has previously been charged against steel pipe. The lining is centrifugally applied to the steel pipes and is generally specified to be 3/32 inch in thickness with a tolerance of 1/32 inch plus or minus. The exterior coating is usually poured or spread on the revolving pipes, and is usually about 1/16 inch thick. The interior of this pipe is very smooth, such as to entitle it to a coefficient in the Hazen-Williams formula of from 130 to 140. The bituminous (tar base) material is processed so as to develop an enamel which is tough and which will neither flow nor crack within a wide range of temperature. Steel pipe with spun bituminous coating is now available in all sizes but its use, to date, in sizes smaller than 24 inches has been quite limited.

Reinforced concrete is also extensively used in sizes 36 inches and larger. This pipe is now being used in diameters up to 12 ft. 8 in. as in the Metropolitan Los Angeles Water District conduit and for heads up to, and in excess of, 400 ft. as is the case with the 54 inch line crossing the Platte River Valley at Denver.

At Denver four contracts were let during the past year, aggregating some 30 miles in length, and in size varying from 24 to 63 inch. Steel pipe was designed using coefficient in the Hazen-Williams formula of 130; concrete pipe was allowed 140. This resulted in a differential in diameter in favor of concrete of about 3 inches on a 60 inch size. On all of the contracts competition was taken between spun bituminous lined steel and reinforced concrete of the cylinder type. In the competitive designs the steel was stressed to 11,000 pounds per sq. in. in both types of pipe except that 1/16 inch was added to steel pipe thickness to compensate for corrosion. Under this competitive system of bidding one contract went to steel and three to the Lock Joint Pipe Co. on concrete pipe. For the small sizes (24 and 30 in.) the contractor was given the option of including cast iron (Class 150) along with the steel and concrete, but no bidders submitted figures on cast-iron in these sizes.

Pipe Line Leakage

Up to a few years ago new constructed pipe lines were required upon test to show leakage of less than 200 to 250 gallons per 24 hours per inch of diameter, per mile of pipe. Improved construction methods have greatly reduced this figure and it is now practicable to secure leakages well below 100 gallons per inch-mile-day. In fact, some pipe lines constructed during the past year have shown a test leakage of less than 20 gallons per inch-mile-day. While it is practicable to secure these lower figures, it is not believed to be good practice to specify too low a figure. The character of work which the contractor is required to do to secure leakage of 100 gal.-inch-mile-day may result in a leakage of 20 gal.-inch-mile-day, but the purchaser would probably pay a substantial premium if he were to ask for a guarantee of as little as 20 instead of 100. Either specification would require the contractor to do the best work of which he is capable.

Good practice at the present time, even in distribution system lines, is to isolate sections between valves and test for leakage. The use of lead substitutes has largely displaced use of caulked lead joints and are proven comparable on leakage tests. Flexible gasketed couplings are becoming more widely employed and especially so on lines subject to considerable expansion contraction or localized movements. Their greatest application has been in connection with modern long length steel pipes, notably in supply mains and to a lower extent in distribution systems.

Automatic Valves

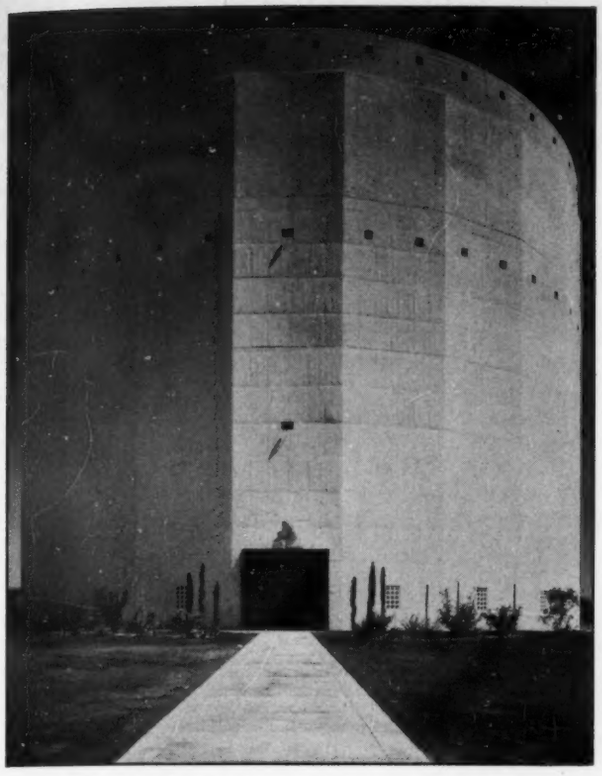
In view of the volume of supply line construction work which has been in progress during the past year or two, it is not surprising that greater consideration has been given to the use of automatic cone or plug type valves which will minimize water hammer, isolate breaks, and minimize the damage resulting therefrom.

Long pipe lines of this type are peculiarly subject to the effect of surges which, if not controlled or released, will introduce severe stresses upon the pipe line; and, when main supply lines break, serious damage usually results.

Denver and Los Angeles have been prompt to recognize the advantages of automatic valves also in their complicated multipressure storage and distribution systems.

At Denver, for illustration, the water is regulated as it leaves Ralston reservoir by automatic cone valves which control its delivery either to the ten mile 42 in. Ralston conduit leading to the Moffat filter plant, or its diversion for irrigation use. At the filter plant another

A 36-in. Automatic Cone Valve (with Relief Valves)—Regulates Gravity Inflow to Moffat Filter Plant—Denver.



One of the 3,000,000 Gal. Steel-Concrete Tanks at Sacramento, Calif.

valve of the same type, float controlled by water level in the coagulation basins (variation of 1 in. permitted), regulates the flow of water into the basins so as to keep in pace with the rate of filtration. The turning on and off of valves and filters in the plant requires no manipulation of valves on the supply line, with the inherent danger of creating supply line surge. This regulation is accomplished by the automatic cone valves on the influent line to the coagulation basins on which the head varies from 185 ft. at static flow conditions to 0 at pipe line capacity.

After the water leaves the filter plant clear well it flows into a 63 in. gravity main leading to two high level districts separated from each other by the Platte River Valley and having different elevations and therefore different pressure requirements. When the filter plant is producing more water than these districts require, the surplus is automatically by-passed through a cone pressure controlled valve to the low service reservoirs. Automatic cone check valves are also indicated on both sides of the Platte River so that a washout in the line would not empty the system.

When these pipe lines and valves are completed, which will be early in 1938, three pumping stations will be completely closed down and a fourth will operate only part of the time. All of this is made practicable by the automatic regulation of the pressure controlled cone valves, which minimize water hammer and maintain pressures in the 30 miles of feeder mains leading to and across the city.

It is now standard practice on installations of centrifugal pumping equipment to utilize automatic cone valves, instead of check valves. Their operation is so adjusted as to open when the pump starts and close when the pump stops, with the rate of movement such as to hold surge in the discharge lines to a minimum.

The use of automatic cone valves at strategic points on feeder mains is also advancing, due to the difficulties experienced in closing large valves under free flow conditions set up as the result of line breakages.

Elevated Tank Construction

The principal change in elevated steel tank construction during the past year has been the more prevalent use of welding as contrasted to riveted construction. With the improvement in technique and methods, and the greater accumulation of experience, welding has come to assume an important position in the fabrication of elevated steel tanks. Beginning with its use in the supports and riser pipes about 1930, welding has been developed until today it is largely being used in the cylindrical shells as well. One of the largest builders of elevated steel tanks has adopted welded construction as standard on all sizes 500,000 gallons and above, a complete transition from riveted practice within one year. Welding improves the appearance as well as the water-tightness and safety of design.

A committee of the American Water Works Association has been working for the past year or more on the preparation of standard specifications for welded tanks and standpipes, supplementary to the riveted steel construction specifications approved by the Association a year ago.

The outstanding development in new type construction of elevated tanks during the past year was that at Sacramento where two tanks or balancing reservoirs, each holding 3,000,000 gallons, were constructed. These tanks are a radical departure from the conventional design. Each tank has a diameter of 144 ft. and maximum wetted wall height of 26 ft. Their flow line is 100 ft. above ground. The tanks are in reality a combination of reinforced concrete and welded steel construction. The water storage compartment is supported upon a cylindrical concrete shell. The wall thickness varies from a minimum of 10 in. to a maximum of 17 in. with an average of 12.5 inches. The wall is reinforced both on the interior and exterior faces.

The floor of the tank is of reinforced concrete. In addition to the cylindrical exterior wall supporting the floor and tank shell, there are 44 reinforced concrete columns arranged in three concentric rings whose diameters are 24 ft., 64 ft., and 109 ft. respectively. The steel shell of each tank is embedded in the floor concrete and so anchored to it as to act both as a vertical cantilever and in hoop tension.

The cylindrical steel shell of each tank is of welded construction so designed as to be capable of taking the entire water pressure. The exterior concrete shell is for protection and appearance rather than for taking stress. The steel shell construction was completed and the tank tested for leakage before the exterior concrete shell was poured. When the concrete shells were poured the steel tanks were filled with water so that each was in tension when the concrete walls were cast around them. Previous tests had shown that the bond between the steel plate and the concrete would be sufficient to hold the two together but steel strap anchors were put in as an extra precaution. Experience has shown that the anchors would probably have been unnecessary. The concrete and steel act together as a unit which in effect means that when the water is low in the tank the concrete outer shell is in compression and prestressing is effected. As a result of this action the concrete walls will never be in tension from the water pressure.

Although no competitive figures were taken it is stated

that the cost of this concrete envelope and steel shell construction was less than the estimate for a structural all-steel tank of the same height and capacity.

Continued improvement is evidenced in the appearance of elevated tanks. The above described Sacramento tanks are examples of what has been attempted and accomplished in this respect. The appearance of elevated steel tanks has been decidedly improved in the past few years, largely starting with the design competition carried on by the Chicago Bridge & Iron Co. Several large elevated tanks have gone into service during the year, with benefits to water service as anticipated.

Aluminum has largely displaced other paint materials for the painting of the exterior of elevated tanks and standpipes. The excellent record of aluminum paint with respect to durability, its appearance and the ease of application, are materially in its favor and instrumental in its very large use at the present time. Spraying of the paint is rapidly displacing brush application.

were entirely inadequate for the rapidly growing industrial requirements. Industries had developed their own supplies to the extent of 120 M.G.D. and had fully appropriated all readily available sources. Without additional industrial water supply for Birmingham, its industrial growth was checked. A specially chartered semi-public commission was organized to develop a supply for distribution to the industrial consumers only.

The Birmingham project, which will cost $6,000,000 includes an impounding reservoir, an earth dam 185 ft. high and 1,600 ft. long, storing 21 billion gallons of water, and a 39 mile 60 in. welded steel pipe line which carries the water from the reservoir to the distribution system. A 120 billion gallon capacity distributing reservoir is constructed midway along the transmission line to provide a factor of safety in case of breakdown and also to permit intermittent pumping at the impounding reservoir when demands exceed the gravity flow capacity of the main. The project is financed by the sale of city bonds supported by revenue derived from the operation

Tangent of 60 in. Supply Main—48 ft. Sections, Jointed with Flexible Couplings—Birmingham, Ala., Industrial Supply Project.

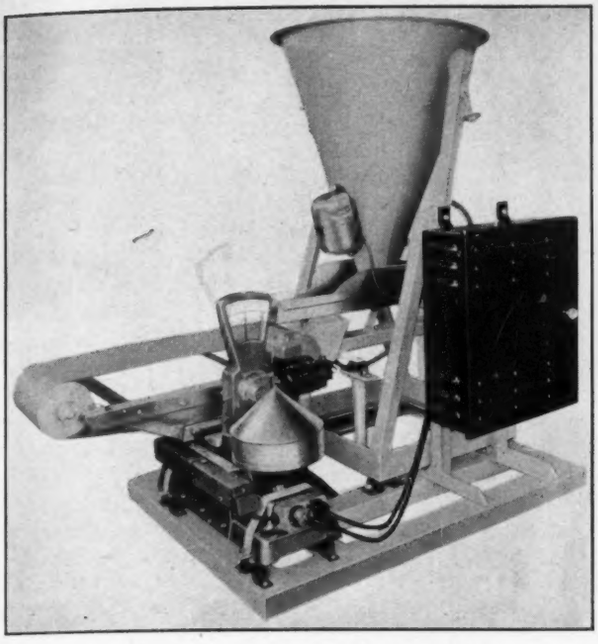
Industrial Water Supplies

The year 1937 was marked by the construction of two pioneer industrial water supplies constructed, however, under widely differing conditions. These supplies were constructed at Charleston, S. C., and at Birmingham, Ala. At Charleston the water supply is municipally owned. The construction of the industrial project consisted of a material enlargement of the existing facilities, including an 18.5 mile tunnel 7 ft. in diameter. The construction was done by the city at a cost of approximately $1,000,000.

The Charleston construction was prompted by a proposal made by a paper company that if the city would guarantee a water supply having a minimum capacity of 25 million gallons per day, the paper company would locate a large new mill at Charleston. The city lost no time in taking steps to secure this important industry.

At Birmingham the domestic water requirements are supplied by a private company, whose sources of supply of the system. A sufficient number of industries in Birmingham signed contracts for water to guarantee payment of the bonds.

These two important construction projects are believed indicative of progress in the water works field. Water works unlike most other utilities, have been content to supply demands which came to them but have not been actively promoting increased sales. As a result, instead of public water supplies being the absolute monopoly which most people assume them to be, they are in fact competing with supplies developed for and by industries using large quantities of water, and by the railroads. This dual development is ordinarily not in the interest of economy but has arisen largely from the inability of the local water utility to furnish, with assurance at all times, the demands of industry. In most cases, it is believed that the development of an adequate supply of water for all industrial purposes can be most economically done when combined with the development of a supply for both commercial and domestic need.



One of the New Gravimetric Feeders

Replenishment of Underground Storage

The storage of water in sand is not new. Los Angeles has practiced it for several years and it has been a commonly accepted practice in the desert areas for a century or more. However, within the past year the Santa Clara Valley Water Conservation District has made a combined reservoir and subsurface storage project which is unique in water supply development practice.

The Santa Clara development depends for its success upon the storing of flood waters (formerly lost by the rapid discharge to the ocean) in detention reservoirs and later releasing the water thus stored for absorption in the down stream gravel where they are available for irrigation or other uses. This development is now passing through its first year of operation and it is reported that the preliminary results have been very gratifying.

Effect of Cheap Money Upon Municipal Ownership

With interest rates from 1 to 2 per cent lower than normally prevailing, renewed impetus was given to the municipal acquisition and ownership of utility properties, particularly water works. The percentage of water works municipally owned (already in excess of 80 per cent) increased somewhat during the current year, and had it not been for a stiffening of interest rates in the last six months of the year other purchases would undoubtedly have been consummated. Some of the purchases have been made in connection with the construction of new supplies. Little Rock is an example of this type of transfer. Others, such as Freeport, Ill., and Delaware, Ohio, have not been accompanied by extensive construction programs. In the early part of the year when interest rates on water revenue bonds were as low as 3 per cent, the cost of interest and amortization expense over a thirty years period was approximately 5.25 per cent. Under these conditions, it is not surprising that municipal financing houses seized upon the opportunity to advance the argument that a city could at this time acquire the water works property, pay for it over a thirty year period and during the interim have rates no higher than those required by the private utilities to pay a fair rate of return. Further than this, at the end of thirty years the city would own the plant.

Some few cities attempted to acquire plants by condemnation. However, the laws of condemnation as applied to public utilities in general follow a course so uncharted as to make the bonds not readily salable. Practically all properties that were transferred from private to municipal control during the past year were changed by negotiations rather than by condemnation proceedings.

Effect of the Depression Upon Municipal Water Works Operations

The depression and the resulting lowered percentage of tax collections has been one of the principal factors in the raiding of water works funds and the diversion of water works surplus to ordinary municipal channels. This procedure has probably been more acute in the past five years than at any prior time in water works experience.

In general, the average American city increases in population approximately 3 per cent per year. The average value of water works properties at the present time is in the neighborhood of $50.00 per capita, so that approximately $1.50 per capita per year is required to keep construction abreast of the needs. As the present water works income averages something less than $6.00 per capita it is evident that approximately 25 per cent of the total income should be available and definitely allocated to construction. This, of course, applies by and large to the average plant.

Actual experience has demonstrated that the best deterrent to the diversion of water works funds, as well as the best assurance of adequate service, is through the development of a program of progressive enlargement so designed as to keep pace with the needs and to utilize the surplus in the water works department. This necessitates the development of a construction program for a generation or more in the future. Such a program, of course, should be reviewed at intervals of approximately ten years so as to correct for changes in either the total amount of development or the direction in which it has taken place. Many cities have had such plans prepared and have profited therefrom.

The principal advantages of such a program are:

(1) Excessive obsolescence is prevented.
(2) Facilities are provided when needed thus obviating both the hazard of inadequacy and the ex-

A Spectacular Main Break—50 M.G.D. 60 ft. into the Air.

travagance of making expenditures before they are necessary.

(3) Such a program tends towards uniformity in expenditures and the paralleling of available resources with the expenditures needed for future development.

Des Moines, Louisville, Milwaukee, Evansville, Racine and Kenosha are some of the cities that have adopted this type of policy.

Another result of the depression has been the excessive turnover in personnel. There has been a greater casualty list among faithful municipal water works employees in the past three years than at any other time in history. The remedy for this is indicated in placing the water department under a separate commission, the members of which have overlapping terms, are free from political interference, and have no responsibilities other than the operation of the water works plant so as to furnish a maximum of service at minimum cost.

Water Works Employes Pension Retirement System

The Federal Social Security Act which provided for all employees in private employment in the United States has directed attention to the fact the Municipal Water Works employees are not provided for under this act. It has further directed attention to the desirability of the Municipal Water Works inaugurating some such similar provisions for its employees. Probably this can best be done by the individual water works and a large number of cities have already worked out such a plan. Some of these are discussed by Leon A. Smith, Supt. of the Water Dept. of Madison, Wis., in the August, 1937, Journal of the American Water Works Association. Discussion of Mr. Smith's paper at the Buffalo Convention indicated that this was a live subject, and one receiving consideration in a great many cities at the present time. Many cities, illustrated by Los Angeles, already have excellent pension and retirement systems in operation.

Cross-Connections

A few years ago when the topic of cross-connections was announced most water works men visualized a connection between the city water system and some industrial system. In recent years there has been a growing appreciation of the fact that instead of a relatively small number of connections between parallel systems there are in effect thousands of connections between polluted water and the pure water in the city mains. These connections come through faulty plumbing, the workings of which are little understood by the property owner and not much better understood by the plumber making the installation.

The Department of Health of the State of Wisconsin, in cooperation with the plumbing inspection department, has issued a most comprehensive booklet "Cross-Connections in Plumbing and Water Supply Systems." The information in that booklet is well worth careful study. This book or its equivalent should be in the possession of every water works superintendent.

Last Year and This

The American water works industry in 1937 faced new emergencies, extended its frontiers of knowledge into new fields, consolidated prior achievements, and made real progress in delivering a pure palatable, noncorrosive water to its consumers. It can enter 1938 with pride in the past and assurance of still greater accomplishments in the future.

David A. Heffernan Passes

Dave Heffernan (Attending His Last Convention)

David A. Heffernan, Superintendent of the Water Department of Milton, Mass., died on November 24th, at his home in Milton. He was 68 years old.

Long a member, and a Past President of the New England Water Works Association, he was well known as an efficient, faithful and conscientious water works manager and association member. He was liked and respected by all who knew him. He had been a member of N.E.W.W.A. since 1902 (serving as President in 1923-24) and in 1918 was awarded its Dexter Bracket Medal for his paper "Practical Methods of Detecting Leaks in Underground Pipes." In 1935 he received a certificate of recognition from the Association, for having served his community as the Water Department head for 43 years, 33 years of which he had been an active and valued member of the Association. He was also a member of the American Water Works Association and an active committee member.

Mr. Heffernan was born in Dedham, Mass., April 16, 1869. In 1889 he moved to Milton to become Superintendent of the Brush Hill Water Company, which became the Milton Water Co. and was later (1892) purchased by the town.

"Dave" Heffernan as he was known to his many friends and admirers, will be missed at water works meetings which he attended so regularly. The Chairman could always count on "Dave" Heffernan to "start something" in the way of a discussion—and for that he had a flare. He had his convictions and stated them in a forceful and interesting manner. He had many pet theories and also many good ideas, and was always willing to help younger and less experienced men who sought his advice. "Dave" Heffernan will be missed as a faithful member of N.E.W.W.A., and as its "No. 1 Round-Tabler," who on his feet was always interesting to listen to. In any discussors battle he could hold his grounds. Yes; and he will be missed too by the community he served for these 43 years, in more ways than one. He was a good Catholic, and a No. 1 Citizen.

Moses Made Chief Engineer, Pa. Dept. of Health

H. E. Moses

Howard E. Moses, for several years Assistant Chief Engineer of the Pennsylvania State Department of Health, has been made Chief Engineer succeeding W. L. Stevenson, recently resigned.

Mr. Moses is a native Pennsylvanian—born in Muhlenberg (1875) and graduated by Dickinson College (1898). In 1908 he went with the Pa. Dept. of Health as Assistant Engineer and since 1922 served as Assistant Chief Engineer. He is a member of A.S.C.E., A.W.W.A., Penna. Sewage Works Assn., and other technical societies and associations. He has for the past several years served as Secretary of the Board of Control of the Federation of Sewage Works Associations and has long been a leader in the Pa. Sewage Works Association, which he served one term as its president. Congratulations, "Ted"!

SLUDGE DEWATERING ON VACUUM FILTERS

The following papers were presented by the individual authors before the Sanitation Section of the American Society of Mechanical Engineers in New York City on October 6, 1936.

Interesting and valuable are the disclosures contained in the three papers presented by representatives of the three manufacturers of vacuum filters for sludge dewatering. It appeared to WATER WORKS AND SEWERAGE, *after the presentation and discussion, that much of value would come from having all three of the papers printed together in a single issue. Permission to do so was asked of the Society, through the Chairman of the Section, and was granted. To A. S. M.E., Chairman Wm. Raisch, and the three authors concurring, we are appreciative.*

We hope that the readers of WATER WORKS AND SEWERAGE *will find as much of interest and value in the three papers as the A.S.M.E. audience seemed to find. It is regretted that the enlightening discussion that followed their reading can not be likewise presented in this issue.*

I

Vacuum Filters for Dewatering Sewage Sludge

With Special Reference to the Conkey Rotary Filter

By S. I. ZACK

Sanitary Engineer
Filtration Equipment Corporation
New York, N. Y.

MECHANICAL filtration for dewatering sewage sludge is being adopted by a good many of the larger and some of the smaller municipalities, especially in more congested areas.

S. I. Zack

History

In 1869 Munson perfected a suction filter wherein false bottom tanks were subjected to vacuum, but due to the difficulty of sludge removal, numerous attempts were made to obtain a means of continuous filtering. One of the first of these was a perforated drum type of vacuum filter, made by J. Droschot of Paris in 1893. A few years later, in 1896, the Solvay Company put into commercial use such a device for the dewatering of bicarbonate of soda. It was not, however, until 1903 that the multiple compartment vacuum filter, which is the type now generally used, was invented by George Moore.

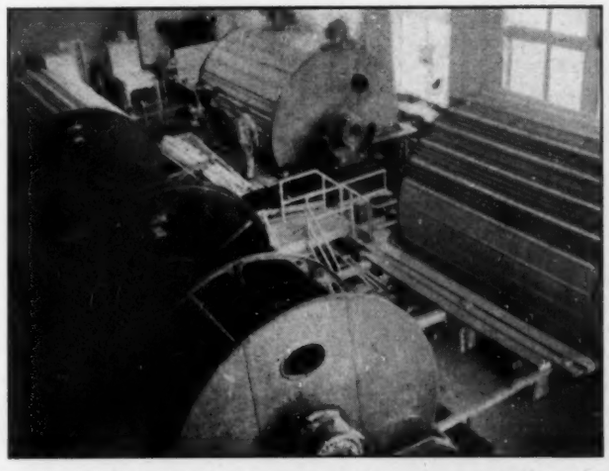
This made possible the separation of wash water from filtrate and the use of compressed air for discharge of the filter cake. This filter was developed for the cyanide process and was confined almost exclusively to mining until 1914, when the Industrial Filtration Division of the Moore Filter Company entered the general industrial field. Among the first investigations were sewage sludge filtration, particularly with the idea of using sludge as a source of fuel.

In the early work, filter aids consisting of flue dust, coal dust, copperas, lime, alum, etc., were used as conditioning agents. While filtration itself was successful from the standpoint of removing water, the costs of conditioning were such as to make it impractical at that time.

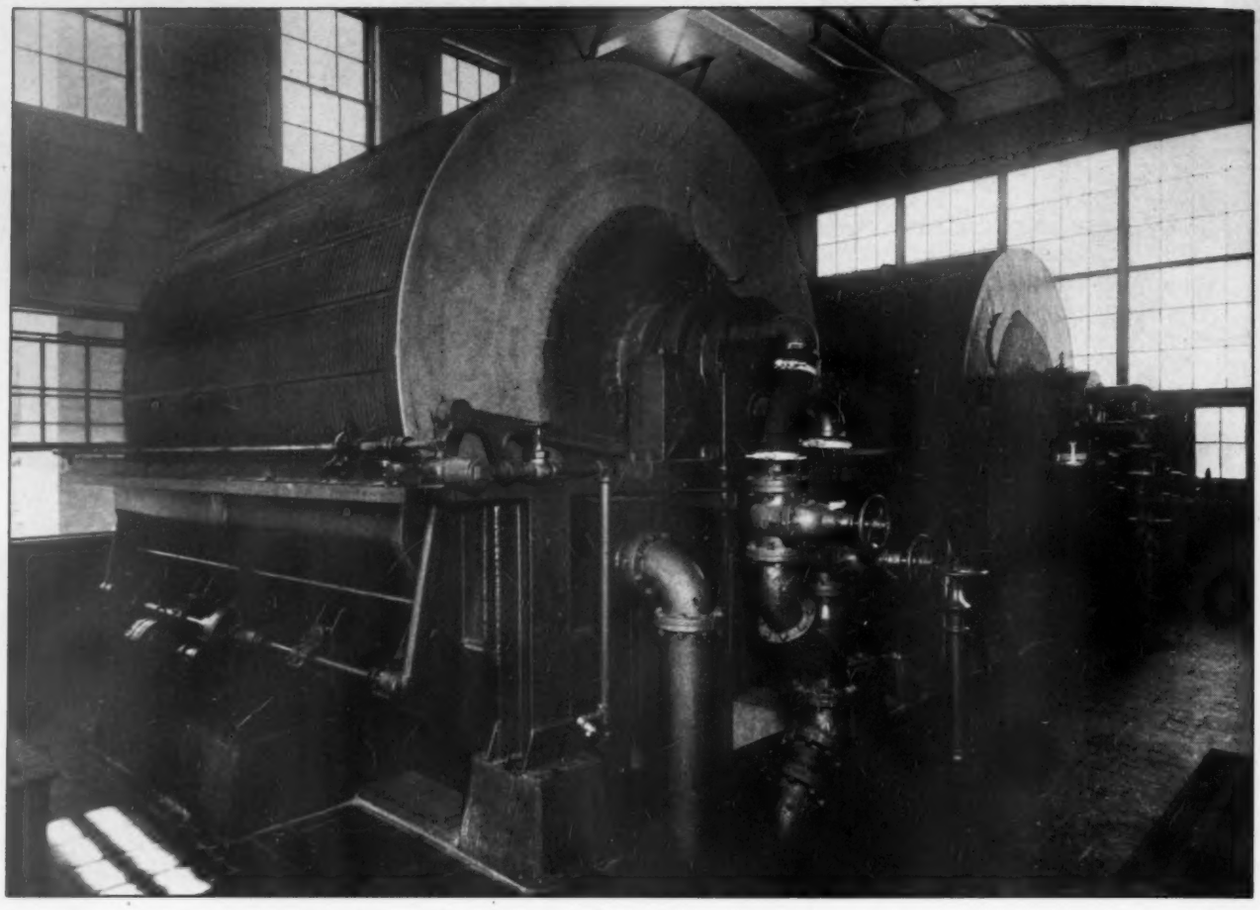
Vacuum drum filters are now being used extensively in almost all process industries where filtration is a factor, including such fields as paper, chemical, explosives, rubber, mining, wood substitutes, steel mill by-products and industrial wastes as well as on domestic sewage sludge.

Dewatering of sewage sludge by rotary vacuum filters became a sound possibility with the improved knowledge of appropriate chemical agents for conditioning. Early conditioners successfully employed were lime, sulfuric acid and aluminum sulphate. It may be stated, however, that the economical use of the rotary vacuum filter for the dewatering of a variety of sludges did not come into practical being until after the development work of chlorinating ferrous sulphate by Palmer and Mohlman in the Sanitary District of Chicago to produce "chlorinated copperas" for sludge coagulation, and its later application on a large scale at Houston, Texas, and Milwaukee, Wis.

The development and full working scale use of incinerators for sludge disposal, starting with the Raymond Mill and Combustion Engineers furnace at Chicago and



The Four Conkey Filters at Washington, D. C. (Photo Produced to Show Construction. Each Unit Is 11 ft. 6 in. Diam. with 14 ft. Face—Now Handling Plain Settled and Elutriated Digested Sludge.)



Twin 10x10 Ft. Conkey Filters at Auburn, New York. (This View Shows the Valve Ends of the Units for Plain Settled and Chemically Precipitated Sludge.)

the Nichols-Herreshoff multiple Hearth furnace at Dearborn, in the past few years has led to a still wider application of vacuum filters for the purpose of preparing a sludge cake with sufficiently low moisture content to be burned.

Some of the larger cities recently to adopt rotary vacuum filters are Washington, D. C., Chicago, Minneapolis-St. Paul, Cleveland, Baltimore, Detroit, Buffalo and New York City. In New York City at the Coney Island Plant a vacuum filter will be used as an auxiliary to liquid sludge disposal at sea.

Filtration Principle

The filtration principle, as used in connection with sludge, is one of separation of solids from liquids and, as such, is a physical problem subject to Poiseule's formula covering the flow of liquids through a porous medium, which is taken as

$$\frac{dq}{dt} = \frac{P}{RT}$$

Where, $\frac{dq}{dt}$ = rate of flow with respect to time,

P = pressure of mixture,

R = resistance of material, and

T = thickness of the material.

This is further modified by the temperature and viscosity of the liquid. The rotary vacuum filter described in the following is now designed so as to carry out in practice the principles set up by this theory.

Vacuum Filter and Auxiliaries

A complete rotary vacuum drum filter installation consists of sludge pump or bucket elevator, chemical feeders, sludge conditioning tank, vacuum filter, vacuum receiving tank, moisture trap, dry vacuum pump, filtrate pump, blower, filter cake conveyor and sludge cake hopper.

Filter Media and Drum

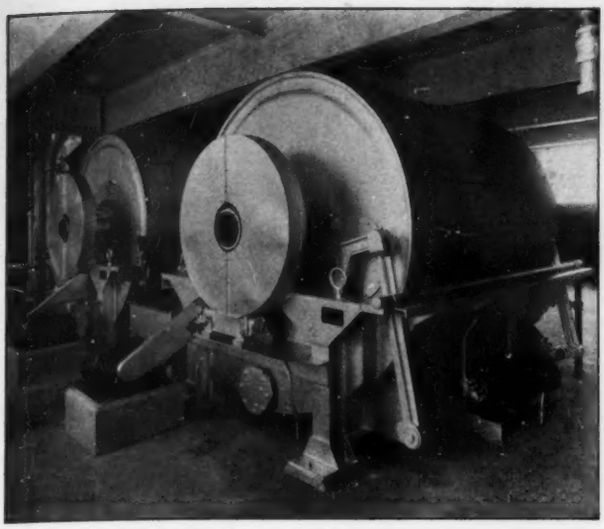
Filtering is accomplished through a cloth media on the drum, rotating on a horizontal axis, suspended in a container. The drum rotates through sludge in the container submerged to about one-third of its diameter. The drum surface is sectioned off into compartments provided with individual drainage to a valve hub and covered with a filter cloth appropriate to the sludge being handled. The compartments are connected through a rotating hub valve, to vacuum for pick up and drying, and air is blown back for discharge and cleaning. The vacuum causes a layer or cake of sludge to adhere to the filter cloth during submergence and the water in this cake is sucked out of the sludge by the vacuum as the drum emerges into the air.

Vacuum

Vacuum is produced by means of a rotary or reciprocal type of pump piped through a moisture trap and vacuum receivers. The vacuum receiver catches the drainage from the filter and is discharged through filtrate pumps. A barometric leg attached to the moisture trap prevents water from getting into the pistons of the dry vacuum pumps.

Air Blow-Back

At the point of filter cake discharge an air blow-back is introduced lifting the cake off the cloth and making possible its discharge onto a conveyor or hopper by means of a scraper.



Twin 8x8 Ft. Conkey Filters at Neenah Menasha, Wis. (This View Shows the Drive End of the Units for Plain Settled and Digested Sludge.)

The use of compressed air is for the double purpose of releasing the filter cake for discharge over the filter scraper and for cleansing the filter medium. The air blows back the solids which have become embedded in the interstices of the filter cloth by the vacuum, which if not removed would tend to blind the filter cloth and reduce the efficiency if not entirely stop the operation.

The Conkey Rotary Vacuum Filter

The Filtration Equipment Corporation's Conkey Rotary Vacuum Filter is an outgrowth of the Industrial Drum of the Moore Filter Company, on which filter runs were made on sewage sludge in New York City as early as 1915. The use of the Conkey Filter in various industrial plants dates back to 1923 and on sewage sludge to 1925 when tests were conducted on filters for export. In 1934 a small 2 ft. x 1 ft. unit was built and operated on chemical sludge at the Coney Island Test Plant. The first large scale operation of the Conkey Filter on sewage sludge consisted of two 8 ft. x 10 ft. units installed at Perth Amboy, N. J. Here it was demonstrated, by continuous operation, that this type of filter was operative for the dewatering of settled sewage sludge to which lime and ferric chloride had been added for sludge conditioning, but to which no chemical had been added for precipitation of solids to aid settling.

Sizes

Rotary vacuum filter drums customarily are built in diameters of 1, 2, 3, 4, 5, 6, 8, 10, 11.5, 14 and 18 feet with varying lengths of face, usually in variations of one foot for diameters up to 6 feet and of two feet for larger sizes.

Driving Mechanism

The simplest form of drive is through a combined variable speed reduction gear unit for the filter drum with a separate motor reduction gear drive for the agitator. Normally the operating speed of the filter drum ranges from ⅛ to 1 R.P.M. and that of the agitator from 10 to 15 R.P.M.

Drainage Facilities

In operation, the filter drum valve hub turns against a stationary valve cap, through a wearing plate. As the drainage ports, which likewise mean the compartments, come in contact with the vacuum or pressure recess in the valve cap, they are subject to suction, to pressure, or to blank, according to their position in the cycle, thus drawing the water through the filter cloth, pipe line and valve cap to the vacuum receiver, leaving the solids deposited on the drum surface and continuously discharging them in cake formation over the scraper.

Some important points to be borne in mind in this connection are that ample drainage area must be provided for in the individual compartments, friction losses and air or water pocketing must be reduced to a minimum. There must be a correct co-ordination between the vacuum, the cut-off and the pressure sections of the valve, the drying arc should be as long as possible and there should be sufficient flexibility in design to meet varying sludge conditions.

Materials of Construction

Drum filters may be constructed of a wide variety of acid or alkali resistant materials. For alkaline work all-iron construction with cotton as the filter medium is considered most suitable. Wood parts for compartment construction are extensively used where the alkalinity is not too high.

Acid solutions require such materials as hard lead, monel-metal, Everdur, copper, rubber covered parts, etc., with wool or monel-metal as the filtering medium.

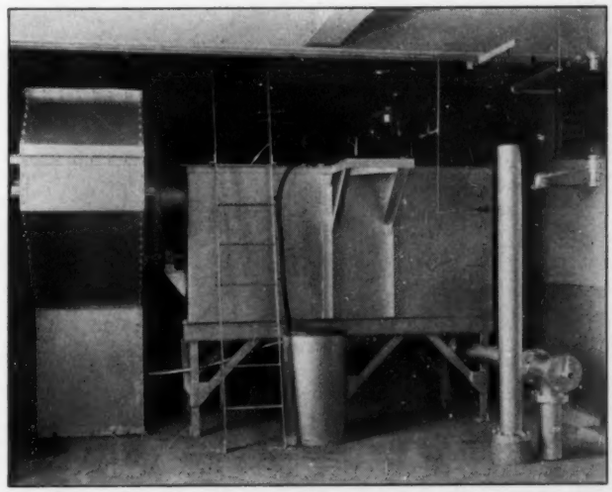
Filters handling sewage sludges, such as activated sludge or elutriated digested sludge, conditioned with ferric chloride only, should preferably be constructed with rubber coated filter drum heads, rubber lined filter tanks, rubber lined filter valve caps, copper or rubber lined drainage piping, monel supporting screens and wire and woolen filter cloth.

Filters handling sludge on the alkaline side such as raw, chemical or digested sludge, conditioned with lime and ferric chloride, are best when constructed entirely of iron, although very often the compartments are of wood. Cotton filter cloths should be used for filtering alkaline conditioned sludges.

Operating Vacuum and Compressed Air

The vacuum employed is dependent upon the kind of sludge being filtered. Free filtering material, although requiring a lower vacuum for cake building, will stand a higher one for drying, whereas sludge which has a tendency to puddle should be built up carefully and the cake should be kept as thin as practical. This is accomplished by means of low submergence and controlled vacuum.

The pick-up vacuum is usually maintained at 24 to 26 inches. of mercury, while the longer applied drying vacuum is usually 20 to 22 inches. The vacuum pump piston displacement amounts to from 1¼ to 2 cu. ft. per



Bucket Sludge Elevator, Automatic Chemical Feeder and Conditioning-Mixing Tank.

TABLE 1

City	Average Design Plant Capacity MGD	Type of Sludge	No. Filler Units	Size of Filters	Pct. Moist. in Sludge	*Conditioner* (Percent of Dry Solids Filtered) $FeCl_3$	Lime	*Yield* Dry Solids lbs. per sq. ft. per hr.	Filter Cake Pct. Moist.
Perth Amboy, N. J.....	10.0	Raw Settled			88	1.8	9.0	7 to 8	65.00
		Chem. Precip.	2	8′ dia. x 10′	88	1.0	10.0	7 to 8	67.5
Lakeland, N. J.....	1.0	Chem. Precip.	2	3′ dia. x 4′	92	2.5	10.0	5 to 6	68.0
New Britain, Conn.....	8.0	Guggenheim	3	8′ dia. x 8′	92	2.5	10.0	4 to 6	73.0
Elmira, N. Y.....	7.5	Raw Settled	2	8′ dia. x 8′	90	2.5	10.0	6 to 8	62.0
Auburn, N. Y.....	...	Raw Settled	2	10′ dia. x 10′	88	3.0	10.0	6 to 8	60.0
Ann Arbor, Mich.....	...	Digested		6′ dia. x 10′		(No data to date)			
		Mixed Act.	1						

sq. ft. of filter area. The compressed air amounts to from 0.2 to 0.5 cu. ft. per sq. ft. of filter area.

Operating Results and Capacties of Conkey Filters

Capacities and yields of vacuum filters vary widely with the type of sludge being dewatered, its density and the amount and kind of conditioning chemicals used.

Table I shows some typical average results that have been reported by various cities.

Power Requirements:

Power required for turning the filter drum and agitator is low ranging from ¼ HP in the smaller units to 2 HP in the larger sizes. This is particularly true of the closed head type where the sludge in the filter tank has a tendency to float the drum. Total connected and estimated operating power required (including vacuum pumps, filtrate pumps, blowers, sludge elevators, conditioning equipment, belt conveyors, etc.) for various sizes and conditions is shown by the records in Table 2:

TABLE 2

City.	Size of Filter.	Connect. H.P.	Oper. H.P.*	Oper. H. P. Per Sq. Ft.*
Lakeland, N. J..... 2-	3′ x 4′	20	11	.14
Enfield, Conn. 2-	5′ x 6′	23	12	.06
Neenah-Menasha, Wis..... 2-	8′ x 8′	58	33	.08
Perth Amboy, N. J..... 2-	8′ x10′	50	27*	.05*
Detroit, Mich. ..... 8-11′6″x14′		652	408	.10
Ann Arbor, Mich..... 1-	6′ x10′	31	19	.20

*All are estimated figures except those for Perth Amboy. The latter are based on actual detailed power measurements under operating conditions.

Some Practical Considerations:

The following practical points, relative to filtering sludges, may be noted in summarizing:

1. As open a filtering medium as possible should be used.
2. In filtering non-rigid solids, pressure does not necessarily make a dry cake.
3. A thin cake offers lower resistance than a heavier one and consequently is easier to dry.
4. The filter cake must be uniform in porosity, and in thickness, for good drying.
5. Proper sludge conditioning—involving considerations of coagulating time, quantity of chemicals, and character of mixing, is essential to successful and economical sewage sludge filtration.

Acknowledgment.—The author desires to make acknowledgment to Mr. G. D. Dickey, of the Filtration Equipment Corporation, for furnishing data and assistance in the preparation of this paper.

II

Vacuum Dewatering of Sewage Sludge

With Special Reference to Oliver Filters

By WARD PITKIN

Engineer, Oliver-United Filters, Inc.
New York, N. Y.

THE use of Oliver Vacuum Filters for sludge dewatering has covered a span of some 12 years. In 1925, three 50 sq. ft. units were installed at Pasadena, Calif., and twenty-four units of the same size at Milwaukee, Wis. These filters are still in operation dewatering activated sludge. Raw and digested sludges are now being dewatered very successfully at higher capacities than activated sludge.

Ward Pitkin

Oliver Features

The Oliver Filter for sludge dewatering is of the low-submergence drum type. No more than one-quarter of the drum is submerged in the sludge slurry for cake formation. The remaining three-quarters is used for cake dewatering and discharge.

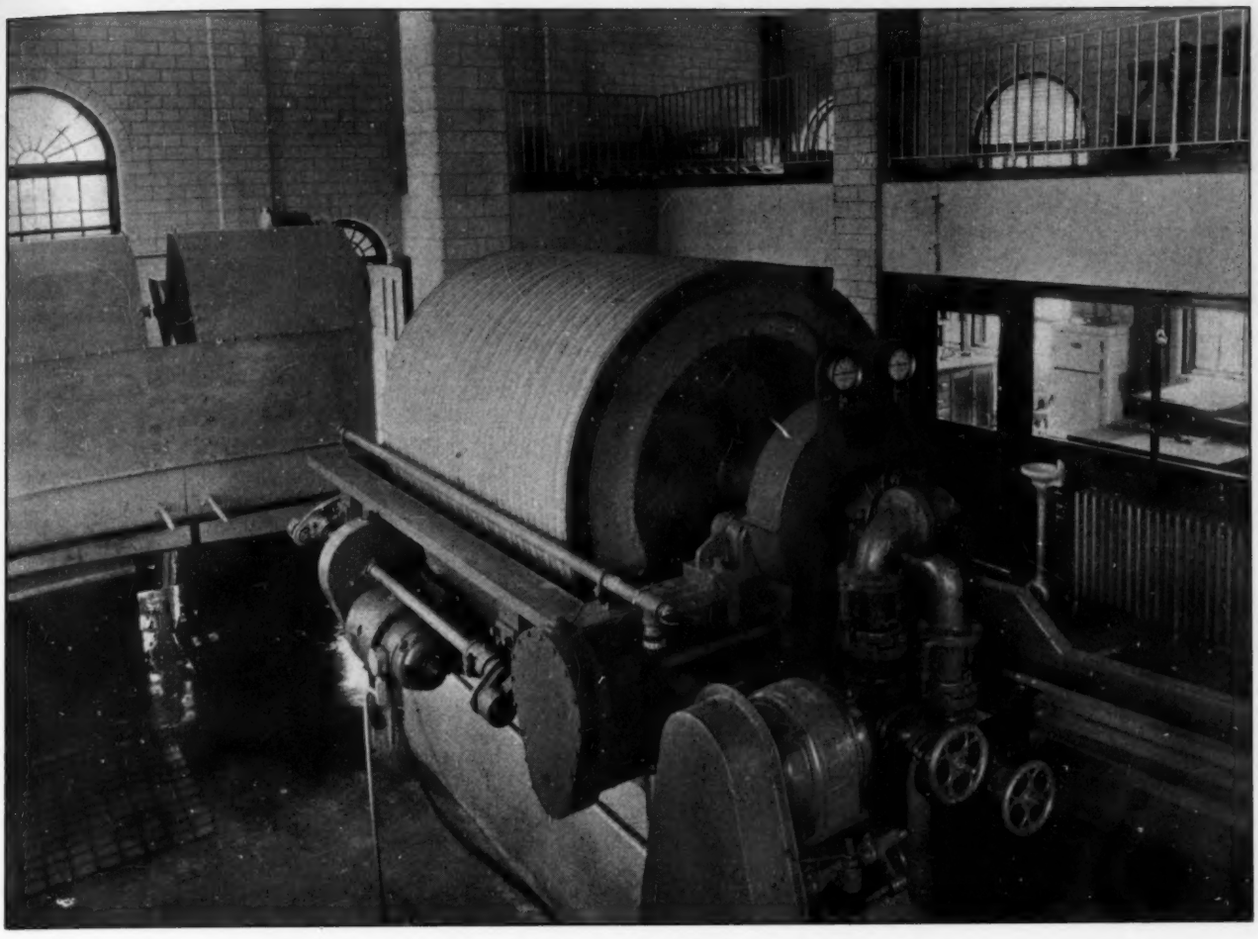
The periphery of the drum is sectionalized, and each section is piped to an automatic valve at the end of the trunnion. Adjustable ports in the valve cause vacuum or pressure to be applied at the correct portion of the cycle. Continuous discharge of cake is effected by low pressure air back-blow, which loosens the cake from the cloth. A scraper blade deflects it to a conveyor or hopper. The entire operation is continuous and automatic.

For good dewatering the sludge must be in a coagulated form. This is a condition such that the water will readily leave the suspended solids. The water is actually removed as the result of approximately 10 lbs. per sq. in. atmospheric pressure. This forms a uniform cake and thereafter presses it.

Chemical Conditioning:

The advantage of chemical coagulation of the wet sludge are many.

1. Water may be removed easily. It is not necessary to subject the solids to extreme pressures which break them down and cause classification.
2. More than 99 per cent of the suspended matter is separated because the fine organic solids are held with the coarser particles.



A Recent Oliver Installation at Middletown, Conn. One of the Improved Units Developed for the Smaller Plants.

3. The filtrate carries approximately 25 to 200 parts per million suspended solids and therefore is normally weaker than the sewage entering the plant. The volume is less than one-half of one per cent of the sewage in most cases. This means no appreciable load on the plant for re-processing. Return of filtrate to clarifiers usually aids sedimentation because of the coagulating action of the chemicals that it contains.
4. High capacities are obtained. As much as 2.5 tons of dry solids per hour may be handled on a single 500 sq. ft. unit. This is the specified capacity for the Back River Sewage Disposal Plant at Baltimore, Md., based on considerable testing.

Chemical Dosage

The amount of chemical required, to properly coagulate the sludge before dewatering, must be determined in each case. We have general figures to guide us in making estimates. These have been obtained from a large number of tests and records of plant operations in practically all sections of the United States.

Genter's work with elutriation (sludge washing) indicates that the chemical demand may be greatly reduced by such pre-treatment of the sludge. Digested sludges apparently carry solubles which may be washed out by the decantation process. The solids may then be coagulated without having to satisfy the demand of these solubles.

The vacuum filter is an ideal device to take advantage of improvements in producing a filterable sludge.

Filter Cloths

Almost any kind of filter medium, if found desirable, could be used. Woolen cloth (12 oz.) is used for acid sludge and 10-oz. cotton cloth for alkaline sludge. It is held firmly to the drum by spirally wound wire. This holds the cover securely when air pressure is applied to loosen the cake. It also greatly increases the life of the cover by protecting it from the scraper. Stretching and sagging are eliminated. The life of the woolen covers is about six months for three shift operations and a year for one shift operation. Cotton covers last about one-third as long, but the cost is much less per cover.

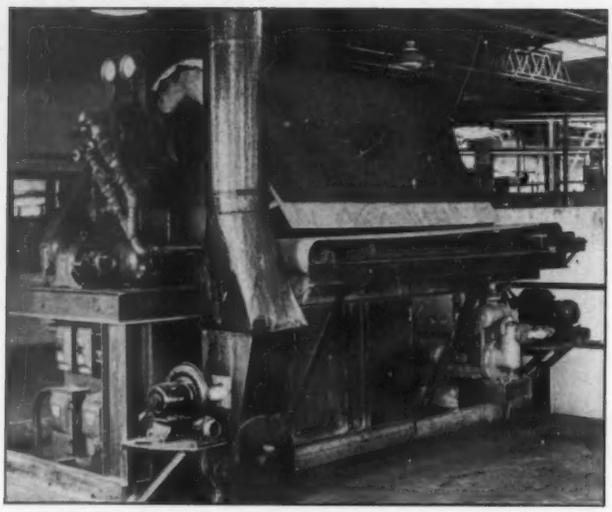
Improved Sludge Take-off

One of the outstanding improvements made in the last few years to the Oliver Filter is the new location of the scraper. It is arranged to discharge the cake below the drum center line. This allows the cake to fall away from the drum by its own weight, causing complete discharge. The scraper then becomes a deflector to guide the cake to the conveyor.

This new location of the scraper is made possible by the low-submergence of the drum. It was found that a relatively short time is necessary to form the cake from well-conditioned sludge. New thickening methods and better control of chemicals have produced higher capacities with the shorter cake formation time.

The Drum and Agitator

The drum shell is built up of wood staves as these are suitable for either acid or alkaline sludge. The outside of the shell forms the bottom of the vacuum section, therefore must be of suitable material to withstand corrosion. Drum heads are closed to prevent sludge from accumulating inside of the drum, where it might become septic if undigested.



An Oliver Filter Dewatering Chemical Sludge at St. Charles, Ill. Note the Thickness of Sludge "Blanket" Leaving the Drum on the Scraper Apron.

The cycle varies from 1 to 6 minutes per revolution, depending on the character of the sludge. A manually controlled variable speed transmission of this range is used for drum drive. The reduction is accomplished by totally enclosed reduction gear direct connected to housed worm and wheel, all mounted on the filter tank.

The largest drums are driven by a 1½ HP. motor. Operation is practically without vibration. No anchor bolts are required.

The agitator which keeps the conditioned sludge uniformly mixed in the filter tank is driven at constant speed independent of the drum. It is hung from the trunnions and is concentric with the drum. Its construction allows it to be rotated to a position above the tank for inspection.

Oliver Unit Capacities

The entire filter is a slow-moving, rugged piece of equipment, designed for 24-hour service and long life. Oliver sludge dewatering units range in size from 54 to 570 sq. ft. Capacities normally are from 2 to 6 lbs. dry solids per sq. ft. per hour, depending on the type and character of the sludge. Power requirements for filter and auxiliaries are approximately 0.125 times the filter area. (This refers to motor ratings. Actual demand varies from .075 to .10 times the filter area, depending on the size of installation and character of sludge.)

Applications

During the past four years, Olivers have been purchased for thirty-eight municipal disposal plants. Twelve were purchased during the previous ten years. Out of a total of fifty plants so equipped, thirty are designed for less than 10 m.g.d.

The following table gives the number of units for different types of sludges:

Activated	41
Digested primary	31
Raw and Activated	28
Raw	16
Chemically precipitated	9
Raw and activated digested	4

The notable increase in filters used for sludge dewatering recently is due to the following advantages gained by their use:

1. Compactness—Filters and auxiliaries may be housed within the plant building.
2. Sludge is quickly dewatered, thereby eliminating odors.
3. Power demand is uniform.
4. Operation is simple.
5. Sound design is insured by experience gained during the past thirty years, in mining and chemical and sugar industries, with filters of the same general type.

III

The FEinc Rotary Filter

Featuring the Continuous String Discharge

By JOHN H. FEDELER

Plant Manager, Filtration Engineers, Inc., Newark, N. J.

J. H. Fedeler

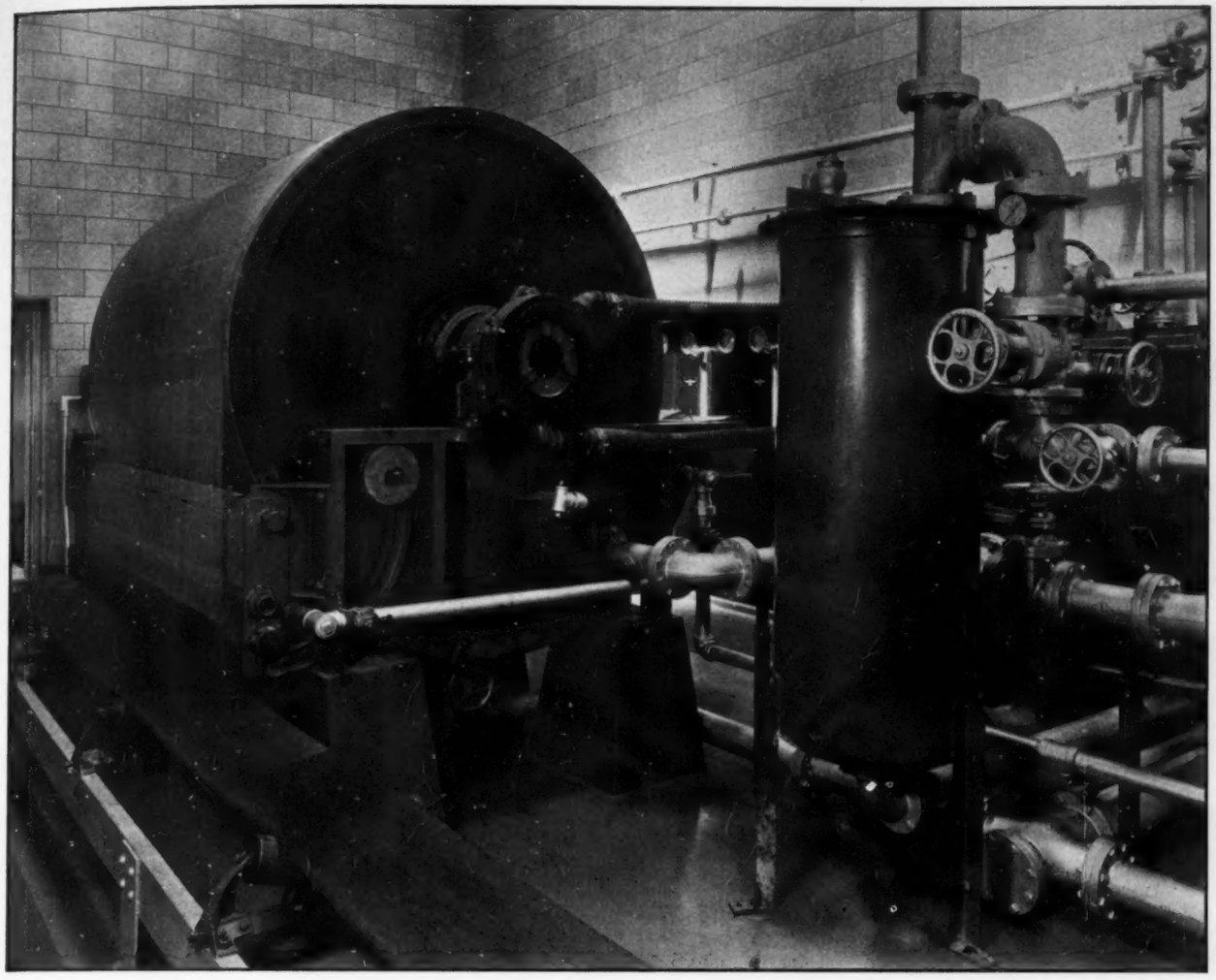
THE first name "FEinc" is a contraction of the firm name, Filtration Engineers Incorporated, which was organized in 1919.

The FEinc Filter may be identified as, and generally classified under, the heading of Continuous Rotary Drum Type Vacuum Filters. It has, however, several individual and interesting features, which distinguish it from its contemporaries. These features are FEinc's Valve, FEinc's Compression, FEinc's Wash Belt, FEinc's string Discharge and FEinc's Drum Dryer. Some of these will be described in detail later in this paper.

Some History:

Geneological references indicate that the FEinc Filter originated from the same genesis as other members of the vacuum filter family. To accomplish the proper combination of a filter and dryer, the organizers of Filtration Engineers accepted the standard rotary drum type filter of that date as a basis for starting the development of the filtering part of the process and proceeded to make improvements, which ultimately developed into the novel FEinc String Discharge Filter.

The first development was of a reinforcing member on which the partly dried solids could be introduced and conveyed through a dryer. Confronted with a problem involving the formation of a thin cake, and successfully conveying it through a dryer, string or cable reinforcing of the sheet of filter "cake" was suggested. After many experiments, it was found that carrying filter cake on strings over long spans while drying was impractical. Everyone was startled, however, at the remarkable way in which strings conveyed the filter cake from the surface of the filter drum into the dryer. The possibilities of universal application of this device as a means of



One of the Twin FEinc Filters at New Brunswick, N. J. Diam. 6 ft. 6 in.; Face 7 ft. Dewatering Settled and Chemically Precipitated Sludge. On Left the Lift Shows the Discharge Strings.

removing the filter cake from the filter drum and conveying it to a predetermined point of discharge was immediately recognized. The string discharge was subsequently introduced commercially and each new installation more definitely confirms its ability. The development of the other FEinc improvements came as a result of the investigation of various applications for the FEinc Filter. The requirements of each application were carefully considered and the filter was developed to best fulfill each need.

The string discharge, along with the valve, are the most notable visible distinguishing features of the filter as it is applied in the sanitation field. The other FEinc developments are applicable chiefly to the various industrial uses, of which there are many.

The FEinc Filter of Today

FEinc Filters may be obtained for commercial application in sizes ranging from 3 ft. dia. by 1 ft. face, up to 14 ft. 6 in. dia. by 16 ft. face. The filtering area of these units varies from 9 sq. ft. to 730 sq. ft. For experimental work 1 ft. dia. by 1 ft. face filters are available.

FEinc Filters are built from various materials, determined by the requirements of the application and desires of the customer. Each filter is individually designed for its job, and the parts are made of the material necessary to withstand acid, alkaline or other corrosive substances that might be present.

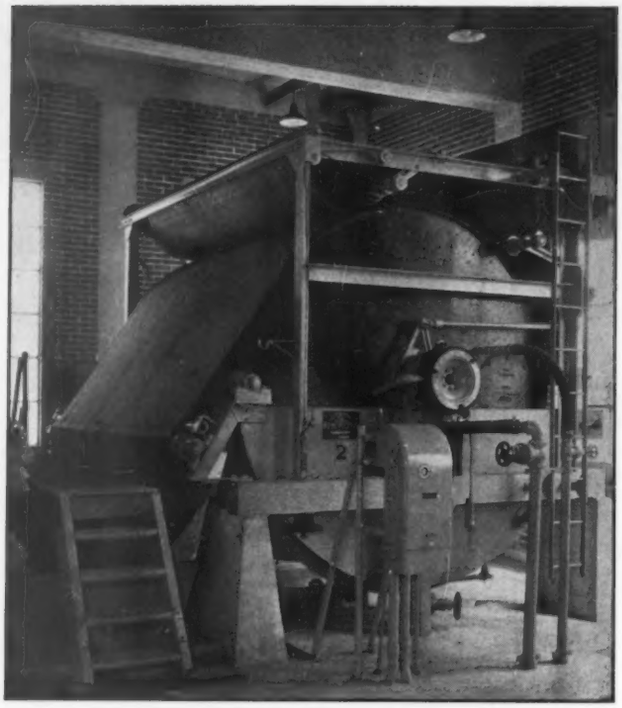
The FEinc Filter used considered standard for dewatering sewage sludge may be briefly described as follows:

The Drum:

The filter drum is built about a cold rolled steel shaft and consists of rubber covered mild steel drum heads, structural steel internal support spiders and wood lagging assembled so as to be water-tight. The surface of the wood lagging is divided into individual vacuum compartments by division strips, and end-seal strips. A copper spiral wire drainage member is fitted into each compartment to afford proper and sufficient support of the filter medium to allow the liquor, passing through the filter medium, direct travel from any part of the compartment to that compartment's drain outlets. Each compartment may have one, two or three drain outlets of hard rubber pipe, properly screwed in and flanged to the wood lagging. These drain outlets are connected to the cast iron valve core by reinforced rubber vacuum hoses, and a hard rubber pipe terminating in a hard rubber terminal plate. The valve core is located directly adjacent to the terminal plate.

The FEinc Valve:

Control of the compartments on the surface of the filter drum is effected by the FEinc valve. It consists of a cast-iron ring fitted over the valve core so that a channel opening in it coincides with the drain line open-



One of the Twin FEinc Units at Hagerstown, Md. Dewaters Undigested Crude and Activated Sludge Mixed.

ings. The valve ring is fitted with lignum vitae plugs properly located to regulate the application and release of vacuum, as well as to make separations of vacuum and liquor flow when desirable. The valve ring is packed on each side so that leakage is effectively prevented. The outstanding advantage of this type of valve is that there are no points of metal-to-metal contact in the presence of the filtrate at which undue wear can occur, if abrasive particles such as grit are present.

Tank and Agitator:

The filter tank is constructed of a mild steel shell properly framed with structural members to support the drum drive, agitator drive and discharge mechanism as well as the drum bearings. The inside of the pan is protected with an asphaltum or rubber coating.

The agitator is of structural steel construction suspended from bearing straps encircling the drum trunnions. It is designed and oscillated in such a manner that the entire volume of sludge in the filter tank is properly maintained in suspension. There is a drive crank and push rod connected to the agitator at each end of the filter so that twist or structural weakness cannot unbalance the operation. The structural members are protected in the same manner as the filter tank. Both are coated with an asphaltum or rubber compound.

The method of suspending the agitator makes it possible to swing it about the drum, with a minimum of difficulty, into a position where it can be inspected or repaired, if need be, without removing the filter drum.

Drum Drive:

The filter drum drive, in most cases, consists of a main worm-gear reduction unit with the wheel mounted on the drum shaft extension, auxiliary reduction units, a variable speed drive and motor. In a few cases, spur gears are used to tie in the reduction units to the filter drum. There is also an increasing tendency to eliminate the separate auxiliary reduction units and variable speed transmission to substitute a compact variable speed drive unit such as those marketed by Reeves Pulley Company, U. S. Electrical Manufacturing Company, Sterling Motor Company, Link Belt and others.

The complete drum drive is designed to rotate the drum within the range of 1/6 r.p.m. minimum and 1 r.p.m. maximum. This speed range gives a selective drum speed to comply with the possibility of frequent changes in the filtrability of the sludge being handled. The variable adjustment also makes immediately available a fast drum speed for washing up, and for cloth changes.

The Filter Cloth:

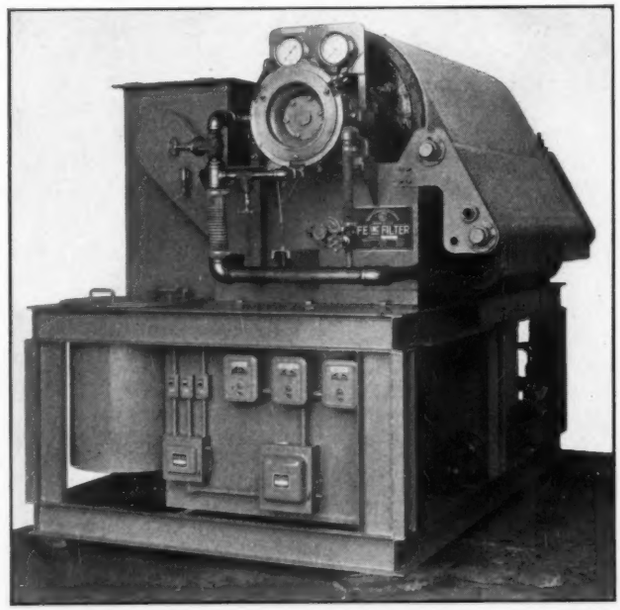
The first step to put the assembled unit into operation is to cover the surface of the filter drum with the proper medium to withhold the solid particles when the flow of liquid is induced through that medium by vacuum. In the case of a sludge conditioned with acid coagulants, such as ferric chloride, wool cloth is the accepted medium. Other materials, however, may be used, the choice being based on the chemicals used in conditioning the sludge, the type of sludge, the desired clarity of the filtrate and the maintenance peculiarities of the installation.

The filter cloth is put on the filter without removing the strings, reeling it onto the drum from the cloth roll, on a removable pipe suspended in front of the drum where it does not interfere with the method of cake discharge. Once in place, the cloth is held by caulking seals.

The String Discharge:

Application of the filter medium completed, the second step of furnishing a means of removing the dewatered solids from the surface of the drum must be considered. Filtration Engineers recommend the String Discharge to convey the cake from the drum and discharge it at the cake hopper or conveyor.

This mechanism consists of a system of miniature cables (strings) each maintained in parallel relationship to its neighbor, at approximately ½ inch centers, by a spacing comb. The path of travel of the knot, which fastens the end of one string to its other end to complete the loop, is on the drum surface. At the point of tangency (point of discharge) it leaves the drum and



Shop Picture of One of the Smaller "Complete" FEinc Units. The drum is 3x6 ft. The Unit Is Complete with Mixing Tank, Agitator, Chemical Feeders, Sludge Elevator, Vacuum and Filtrate Pumps, Air Blower.

travels through space to the discharge roll. It passes partly around it and then through space, and between the tines of the aligning comb, to the return roll. Then partly around that, and through space again, back onto the drum surface. The strings may be of cotton, linen, rubber coated cotton or other available materials. The rolls about which they pass are suspended in self-aligning roller bearings.

In the operation of the FEinc Filter, the solids, loosing their water, form a cake over the strings which lie on the surface of the drum.

The function of the string discharge is to reinforce and lift the solids, in cake (sheet) form cleanly from the drum surface, convey it to the discharge roll where it leaves the strings by gravity, being loosened by the bending travel over the small diameter of the roll. The solids fall away and the clean endless strings return to the drum to convey another load away.

Relative motion involved at the point of discharge during the filter cycle is a cake lifted perpendicularly from the surface of the drum.

Accessory Equipment:

We now have practically a complete picture of the filter in operation. It is not, however, complete without looking at the accessory equipment necessary. Aside from the vacuum pump required, a simple set-up includes a filtrate receiver, a filtrate pump and a moisture trap.

The liquid, entering the vacuum compartments, having left the solids on the filter surface, is separate from entrained air in the filtrate receiver. The liquid or filtrate is then removed from the receiver by the filtrate pump for discharge as desired. The separated air passes to the moisture trap, where vapor is allowed to condense, and is then exhausted by the vacuum pump.

The FEinc Filter has been demonstrated to ably dewater such sludges as undigested primary sludge, digested primary sludge, chemically precipitated sludge, digested activated sludge and a combination of undigested primary sludge and activated sludge. The actual capacities obtained when dewatering each type of sludge may vary because of location, method of sewage treatment or the method of sludge conditioning and handling.

Power Requirements

The connected power required for installations of FEinc Filters dewatering sewage sludges can be briefly summarized by discussing a few typical installations: a small installation, a medium size installation and a large installation. In each case, the installation is equipped with the following drive motors.

Filter drum drive motors.
Filter agitator drive motors.
Vacuum pump drive motors.
Filter pump drive motors.

The small installation has a filter area of 57 sq. ft. It is designed to dewater digested primary sludge at 5 pounds per square foot per hour, dry sewage solids. The water content of the sludge is to be reduced from 95 per cent to 75 per cent. The motors required, to operate the equipment involved, total 5 horsepower. In this case, 26 kilowatt hours are required per ton of dry sewage solids.

The medium size installation has a filter area of 280 sq. ft. It is designed to dewater digested chemically precipitated sludge at 4 pounds per square foot per hour, dry sewage solids. The motors to operate this installation total 25.5 horsepower and require approximately 34 kilowatt hours to dewater each ton of dry sewage solids to a cake moisture of less than 80 per cent.

The large installation has a filter area of approximately 2,500 sq. ft. It is designed to dewater sludge at a capacity of 3 pounds per square foot per hour. The total connected power required in this case is 203 horsepower and 56.6 kilowatt hours are required per ton of dry sewage solids.

In considering the above figures, we must appreciate that the comparison is drawn on total connected horsepower. The actual horsepower required to accomplish the dewatering desired, at the capacity specified, has not to my knowledge been determined. If, however, the small and large installation were working under the same conditions, the power required by the large installation would be only 32.5 kilowatt hours. If the factor of safety for accessory breakdown service were applied, the power required under these conditions would be less than for the small installation.

In closing, we suggest that any comparison of rotary drum type filters be based on the fact that one well designed unit, under the same operating set-up and conditions, will produce (within a reasonable degree) the same results as any other filter. It then seems to follow that one filter must be compared with another on the basis of economy of installation and of performance.

▼

Sludge Values

(A Letter to the Editor)

Dear Sir:

Will you kindly grant me small space in your excellent periodical to correct an impression that might improperly be conveyed by the abstract of my remarks as given on page 415 of your November issue. The abstract states, "He considered sludge of little value as a fertilizer, but to have a worthy place in agricultural economy."

The first part of this abstract is misleading unless a certain meaning is given to the term "fertilizer." If by "fertilizer" is meant a material for growing particular crops, the statement is incorrect, as I believe that sludge is a very fine fertilizer for lawns, flower gardens, trees and most grass and foliage crops.

But if "fertilizer" is intended to carry the same significance that it does to farmers and agriculturists; which is a "balanced fertilizer" equally good for foliage crops, root crops or seed crops; then the statement is correct.

Sludge is usually deficient in phosphorus and potash which are required for the growth of the root and seed crops. For this reason in my talk I recommended that sludge alone should be sold as a "compost and soil conditioner" which would indicate its field of usefulness, and not as a "fertilizer" which agriculturists would compare (to the disadvantage of the sludge) with the usual manufactured "balanced fertilizer." Obviously this does not apply to the larger plants where sludge may be manufactured into a "commercial" or "balanced fertilizer."

The term "fertilizer" when applied to sludge alone is, in the minds of agriculturists, an exaggerated claim and its use does more harm than good. Sludge can be sold at good prices as a "compost and soil conditioner," so why try to claim more, only to injure a growing industry.

Yours truly,

C. G. WIGLEY, Atlantic City, N. J.

[To anyone reading the whole of Mr. Wigley's elucidation on sludge values before the New England Sewage Works Assn., as reported in our November issue, we do not believe there would be any misinterpretation. However, we are glad to insure clarity of his position by reproducing the letter.—Ed.]

Sand-Wash Dam and Gate-House, Pittsfield, Mass.

N.E.W.W.A. DISCUSSES RECREATIONAL USAGE OF RESERVOIRS

Attends Water Works School; Hears About Steel Pipe

THE New England Water Works Association held another of its interesting and valuable monthly winter meetings at Hotel Statler in Boston on December 16th. Even the snow which fell during the early morning hours was no deterrent to a sizable attendance including many from Maine, Vermont, New Hampshire.

The Water Works School a Feature

What has come to be a noteworthy feature of N.E. W.W.A.'s monthly meetings is the series of lectures being given on the "A.B.C.'s of Hydraulics" (with practical applications cited) by George E. Russell, Professor of Hydraulics at Mass. Inst. of Technology. The first hour of each meeting, devoted to the Water Works School, has come to be a drawing card which brings members and guests into the "class-room" at 10:00 a. m. The 1938 "Course" is being given by an experienced teacher, in a manner easy to follow and attention holding. During the closing period Professor Russell answers questions and amplifies the utility and applications of the theory developed, and methods explained, in operating or maintenance and design practice.

In previous 1937 meetings, Professor Russell has been developing the topic "Measuring Water Flows"—previous lectures having been devoted to "Wiers"; the "Venturi Meter and Flume"; and the "Pitot Tube and Pitometer Measurements." The December topic was "Plate Orifies and Nozzles" in which expertly made blackboard sketching served to vivify the underlying principles and development of the theory, points of differential head measurements, and the "do's and don'ts" in the design, the installation and use of the sharp-edged (plate) orifice and the nozzle. The theory of the orifice developed, Professor Russell showed that the nozzle measurements involved the same theory and formulae.

Mark F. Croker, Supt., Newton, Mass. (Chairman of the Round Table)

Edw. H. Thwaits, Cons. Engr., Youngstown Sheet & Tube Co. (Principal Afternoon Speaker)

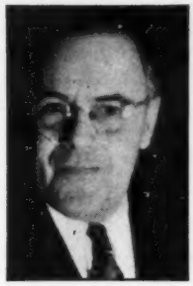
A few of the high-points of the lecture follow: (1) Explanation of the simplified formula for plate orifices, as developed in the hydraulics laboratories of the Univ. of Illinois, and published as its Engineering Exptl. Sta. Bul. No. 109; (2) the importance of smooth walled pipe immediately ahead of the orifice; (3) the importance of making the taps for differential head measurements, to preclude projection of the head-measuring pipe connection through the wall of the main—even the necessity of cleaning the burr from the edges of the hole drilled for such connections; (4) the importance of properly locating the taps on either side of the orifice, 0.8 times pipe diameter up stream, and 0.4 times diameter down stream, for most dependable accuracy and application of the simplified formula; (5) the latitude in orifice diamters in respect to pipe diameter, diameters permissible being from 1/6th to ½ the pipe diameter; (6) contrary to the popular belief the so-called sharp-edged plate orifice need not be sharp edged at all but must have a smooth, flat, thin edge created by the usual bevel of the down stream edge of the opening. In his closing remarks Professor Russell pointed out one weakness of the plate orifice; namely, the high loss of head created and, therefore, the popularity of the Venturi tube because head loss was either usually undesirable, or added to the power cost in pumping.

Memoriam to Dave Heffernan

At the luncheon, was announced the death of David A. Heffernan, Supt. of Water Works at Milton, Mass., and long a member of the Association. He missed but few of its meetings, and spoke his convictions in plain language on controversial subjects brought forth for discussion. So loyal to N.E.W.W.A. was the one and only "Dave" Heffernan, that President Warren Scott asked those in attendance to stand with heads bowed for a minute in memory of him.

Later, ARTHUR C. KING (Taunton, Mass.), Chairman of the Legislative Committee, briefly explained a Bill now before the Massachusetts Legislature which is designed to confer full police powers on water shed patrolmen. By vote the Association endorsed the Bill.

Edw. J. Titcomb, Secy., Cherry Valley and Rochdale (Mass.) Water Distr. (Since 1910 has served on its Water Board)



Arthur R. King, Supt., Taunton, Mass. (Chairman of Legislative Comm.)

Superintendent's Round Table

(Chairman, Mark F. Croker, Newton, Mass.)

The Question of Recreational Use of Water Sheds and Lakes, Constituting Sources of Public Water Supply?

As to be expected, topic No. 1 brought forth considerable discussion in this section of the country, where any form of recreational usage of public supply water shed areas and lakes is considered objectionable if not actually dangerous.

After a few introductory remarks by the Chairman, a written discussion from Harold Bingham, Supt. of Water and Sewerage, Marlboro, Mass., was presented by Mr. Croker. Mr. Bingham's chief problem was that of fishing and he explained that the public associated fishy tastes in the supply (in reality due to algae) with the idea that there were too many fish in the reservoir. Under the belief that fish soiled the water and were undesirable in consequence, it had been difficult to explain to Marlboro fishermen why fishing had been disallowed. Under so much pressure had the water works management been put to allow fishing that it had been necessary to put the matter to vote of the Water Works Commission, which turned thumbs down on the proposal.

The Chairman pointed out that Massachusetts had a General Law prohibiting bathing in, and skating on, water bodies constituting a public supply. Mr. Chase (Boston) explained that all lakes and ponds with an area of more than 10 acres were officially "Great Ponds" and, as such, became the property of the commonwealth. This had made it possible for the Mass. State Department of Health to set up rules and regulations covering such lakes.

DAVID MOULTON (Portland, Me., Water District Attorney) reported that Maine had no such law and, therefore, its cities had to legislate against water supply trespass individually. Long a popular summer resort, bathing in Lake Sebago was not prohibited beyond the 2 mile markers from the city's intake. Fishing parties gave them more concern, however, and a careful record of the number of fishing boats in the region of the intake and the bacterial counts had shown a definite relation. The water pollution laws of Maine required proof of injury and, therefore, the fishing hazard continued a problem because of the difficulty of proving actual injury.

W. W. BRUSH (Editor, Water Works Engineering) stated that New York City had actually been required by State law to allow fishing, picnicking, boating, and even bathing, in its water supply lakes. There had been no proof of danger to the public health since the adoption of multiple chlorination and it was his belief that New Englanders in time, will be required to allow regulated recreational usage of water supply lakes and reservoir areas. From his experience when head of the New York City supply, no health hazard from regulated reservoir usage can be shown. Even bathing, in defined areas, could not be considered so serious a menace as to be prohibited.

L. M. TRAGER (Chief Engr., New Hampshire Dept. of Health) reported a case involving a growing summer colony population on the shore line of a New Hampshire water supply lake. Department regulations had recently been passed to stop fishing through the ice from "Bob Houses," slid over the ice holes to house the fishermen, likewise bathing and disposal of domestic wastes. Property owners were bitterly contesting the regulations, prohibiting shore line bathing and fishing, as unconstitutional and a violation of property rights.

The question came up concerning what might be considered the safe distance from the shore line for location of cottages and waste disposal; what governed the distance specification?

MR. MOULTON, speaking from Portland experiences, stated that no fixed rule was possible. Portland required plans and specifications with the application and only upon inspection of the local terrain and soil conditions could the location of the waste disposal seepage field or pit be fixed. It varied considerably. MR. BRUSH stated that in sandy soil a 200 ft. distance has been proven a safe one on the New York supplies, whereas 50 ft. was too little. MR. MOULTON then told of Portland's development of a regulated and supervised recreational area adjoining Lake Sebago to provide facilities for campers, fishermen, winter sports lovers, et al., and attract trespassers away from the Portland water shed. This plan offered a spot to which water shed patrolmen could direct those ordered off the city owned water shed area near the intake. To them this plan, although expensive, seemed the happiest solution. Interesting, was Mr. Moulton's disclosure that many influential Portland citizens, including medical men, had seriously advocated selling off the city-owned water shed property to residents, regulating sanitary facilities thereon and constructing a modern filtration plant from the proceeds, as a practical solution. (Portland is now operating an experimental filtration plant, involving a novel fine-grained magnetite self-cleaning filter, in conjunction with fully automatic chlorination which has long been practiced by Portland Water District.—Ed.)

What Constitutes an Adequate Water Supply?

Topic No. 2 proved a question with more ramifications than time available permitted discussion of. In brief, it was clear that depreciated conditions of feeder and distribution mains, with pressure losses and deficient

No. 1 Members

Percy A. Shaw, Supt. Water, Manchester, N. H. (N.E.W.W.A.'s Newest Vice President); "Don" Calderwood, Asst. Supt., Nashua, N. H. (Does a Good Job of Handling Round Tables); "Sid" Anthony, Supt., Augusta, Me. (Edits the Journal of Maine's Water Utilities Assn.)

capacities, and lack of adequate storage near the center of population, were the commonest deficiencies of water supply systems in the New England area. Then, it appeared that development of ground water supply as auxiliary to surface supplies was being more generally considered as a "back-log" against supply depletion and heavy seasonal draughts. Several gravel-pack wells had been developed in recent years as the happy solution to temporary shortages. It was noticeable that lack of sufficient storage in elevated tanks seemed a weakness in recent supply improvements.

SIDNEY S. ANTHONY (Augusta, Me., Supt.) drew the envy of many a water works manager when he recounted recent Augusta improvements, and the fact that he could rest fairly easy with 6 to 10 months' supply in storage, twin mains crossing the river, and an 8 day supply in service storage ½ mile from the center of the city.

RICHARD K. ELLIS (Engr., Factory Mutual Ins. Co.) and former Newton, Mass., Water Supt. and Commissioner, in reply to a request outlined what was to be considered adequate fire flows and other fire supply facilities. Of all elements, main capacities were the chief weakness in general and this could be corrected only when the water utility manager had made adequate surveys to detect those mains needing replacement with larger sizes or cleaning to restore potential flows and residual fire stream pressure values.

HENRY E. HALPIN (Engr., Factory Mutual Insurance Cos.) in reply to another question, pointed out that the chief weaknesses were usually on the fringes of distribution systems. Recent betterments, through P.W.A. and W.P.A. programs all over the country, had been marked in respect to providing better service storage and more adequate main capacities. The Buffalo, N. Y., development was cited as an outstanding case in a large city, involving improved trunk main ties with the distribution grid and three new 2,000,000 gal. elevated tanks, boxing the compass on the fringe of the system. Answering a question as to what the improvement had done to lower fire risk rates, Mr. Halpin stated that properties were no longer dependent on private supplies and dangerous cross connections; expensive individual tanks to serve local protection and sprinkler systems, as previously required, were no longer so. There had been no actual lowering of the rate because almost equal facilities had already been required of the owners of the plants, at greater expense to the risk and danger to the public supply, however.

Luncheon time having arrived, further discussion of Topic No. 2 was prevented.

Chemists' Round Table*

(Chairman—Harold B. Scales, Portland Water District)

Topic—**Bacterial and Plankton Analysis of Waters.**

The Chairman, by way of opening the discussion, gave a review of the history, the tests for, and significance of, b. Coli and b. Aerogenes in potable waters, dating back to the first isolation of b. Coli in 1885. In 1905 Standard Methods of Water Analysis appeared with a test for b. Coli—which required 9 days for confirmation. At present, the favored method was that of culturing in brilliant-green broth to eliminate many interfering organisms. Since excreta of man and animals normally contained b. Aerogenes to an extent of but 10 per cent of b. Coli numbers, the finding of aerogenes without coli could not be considered an index of pollution of consequence. Mr. Scales said that he had never experienced a contradiction between the E.M.B. plates and brilliant-green broth until recently. The case was that of samples from the distribution fringes, which showed b. Coli with the latter but negative on Endo or E.M.B. plates. Such was believed to be explained as an "after-growth" or a "pick-up."

F. E. SMITH (Chemist, Cambridge Filter Plant) on lime treated water of pH 9 or thereabouts, had found standard lactose broth to give many positive results where brilliant-green broth gave no gas. Otherwise the two media had checked very closely on Cambridge water and, therefore, they had dropped confirmation by E.M.B. plating and substituted the time saving B.G.B. fermentation tube.

1. A. W. Read, Supt., Bangor, Me.; 2. Dale C. Crosby, Distr. Mgr., Johns-Manville Co., Boston; 3. John Robinson, Asst. Supt., Concord; 4. George Wirtz, Vice Pres., Atlas Mineral Products Co., Mertztown, Pa.; 5. Henry T. Gidley, Supt., Fairhaven, (Mass.) Water Co.; 6. H. A. Hanscom, Founder, Hydraulic Development Co., Boston; 7. A. T. Gifford, Instructor, Mass. Inst. Technology, Son of N.E.W.W.A.'s Frank G. 8. E. A. Merrithew, Supt. Public Works, Saugus, Mass.

Ammonia-Chlorine for Main Growths:

The finding of increases in bacterial counts on the fringes of the Portland system, and elsewhere, brought forth a suggestion from STUART COBURN (Metcalf and Eddy Engrs.) that Mr. Scales might find relief in adopting "Chloramination." In reply, Mr. Scales said that he had tried putting up the chlorine dosage but found that many complaints ensued. His recommeded use of ammonia had not appealed to the Portland authorities so far. The explanation was the wish to avoid further "doctoring" of a good water in which algae was the chief offender.

R. P. JOHNSON (Chemist, Salem-Beverly Plant) advised Mr. Scales that he had been most successful with chloramination in clearing up a like problem, without taste complaints, even in the face of the fact that they had gradually boosted the chlorine to give consumers a chloramine dosage of 0.2 p.p.m. residual without offending their palates.

Sea-Gull Pollution:

The question of sea-gull pollution of reservoirs proved to be another New England problem. At Portland the stringing of wires across a service reservoir, 20 ft. apart, had been as thoroughly effective as in San Francisco in discouraging gulls from attempting to alight.

*To E. W. Moore, Instructor in Sanitary Chemistry, Graduate School of Engineering, Harvard University, we are indebted for having supplied us with notes covering the "Chemists' Round Table."—Ed.

C. I. Pipe Ring-Aerator and Basin at Sand-Wash Reservoir, Pittsfield, Mass.

During the past 5 years only one gull had made a safe landing. The increased cleanliness of the water had been evidence of the efficacy of the method. F. E. SMITH's Cambridge cited experiences, which confirmed Mr. Coburn's opinion that gulls were a serious contributor of b. Coli from polluted harbor-areas as well as gull droppings.

Main Flushing:

Concerning the efficacy of main flushing, Mr. Scales stated that the practice had been largely discontinued in Portland, it having been determined that no worthwhile scouring was obtainable with less than about 10 ft./sec. main velocity, hard to get in practice. Anything less seemed mainly just a stirring up operation to create bad looking and tasting water and complaints. As to b. Coli, flushing offered only temporary clearing up of the positive tests, already referred to, on the fringe of the system.

MR. COBURN suggested that possibly 20 deg. agar plate counts might tell something of what was going on in water systems, which was not adequately revealed by the 37 deg. counts and standard tests for gas formers; at least it was worth thinking about. This brought up the question of why gastro-enteritis outbreaks and what could be done to take existing suspicion away from water supplies. The Fitchburg, Mass., outbreak was a case at point; cited by C. I. Sterling (Mass. Dept. of Health) as typical of a water borne outbreak, although only 10 per cent of the many tap samples showed confirmed b. Coli present, and that ratio dropped to zero in two days' time.

The Chairman commented that from evidence being gathered over the country, there appeared to be some correlation between deficiencies in chlorine residuals and chlorine contact periods, and outbreaks of enteritis which followed 2 to 3 days thereafter.

The Afternoon Session

(President, Warren J. Scott, presiding)

"Steel Pipe for Water Mains," by E. H. THWAITS, Consulting Engineer, Youngstown Sheet and Tube Co., Youngstown, Ohio.

The afternoon session was opened with Mr. Thwaits' illustrated paper, which reviewed the history of steel pipe in water supply service; discussed inherent qualities of steel as a pipe material; gave some reference to the life history of important installations since 1871; developed a discussion of the economics of steel water mains (installation and life); and predicted the future of thin walled steel pipes with modern protective coatings and linings, other means of internal and external corrosion control, and tight flexible (gasketed) mechanical joints.

In the historical review and service records, Mr. Thwaits started with the first American water supply line of steel pipe laid in Pittsburgh in 1871. He pointed to 1,000 installations of steel pipe now known in America, involving more than 16,000,000 linear feet. Getting close to home, he cited Massachusetts installations, already 30 years old and still in service. In Boston, 248,000 feet of larger diameter steel pipe had been laid since 1924; in New York City 410,000 feet. Quoting liberally the highlights from a paper by Rossiter Scott, Consulting Engineer, S. R. Dresser Mfg. Co. (read before N.E.W.W.A. in 1935 and printed in its Journal) Mr. Thwaits recounted the service history of ¼ inch wall steel pipes, the expected life of modern bituminous enamel coated pipes as being 100 years or more, and the observed fact that only 5 to 10 per cent of the mileage of pipe lines installed had to be protected against soil corrosion. Mr. Thwaits also quoted from a paper by Frank A. Barbour, Boston Consulting Engineer (read before A.W.W.A. in 1936 and printed in its Journal) setting forth arguments for protective linings of steel and iron pipes at the slight added costs involved. Then the speaker quoted from the published findings of the U. S. Bureau of Standards Research Papers No. 638 and No. 683 (May 1936) revealing findings of a 10 year nation wide study of soil corrosion, involving a variety of pipe materials (30,000 specimens) from which conclusions indicated that bare pipes of all ferruginous materials had suffered essentially the same rate of cor-

1. "Reg" Hayes, Secy., Hydraulic Development Corp., Boston; 2. Jas. V. Turner, Supt., East Providence, R. I.; 3. R. E. Ferguson, Hersey Mfg. Co., So. Boston; 4. John C. Madden, Youngstown Sheet and Tube Co.; 5. N. C. White, Fields Point Chemical Co., Providence; 6. E. M. Battey, Chemist in Charge, Providence Filtration Plant; 7. W. D. Barker, Distr. Mgr., Wailes, Dove-Hermiston Corp., Boston; 8. William Naylor, Supt., Maynard, Mass.

Discussors

Henry E. Halpin, Engr., Factory Mutual Ins. Co., Boston; Carter H. Lamb, Mgr., Jamaica Water Co., Jamaica, L. I.; Richard K. Ellis, Engr., Factory Mutual Ins. Co., Boston.

rosion (pitting), and establishing the economy of making adequate soil surveys and the adaptation of modern protective coatings in areas where required. As to the coatings studied, the coal tar base enamels had been superior to asphalt base products. Mr. Thwaits then quoted from the well known report of N.E.W.W.A.'s Committee on Pipe Line Coefficients (N.E.W.W.A. Journal, September 1935) to show the role of pH value of waters in reducing internal corrosion rates and ensuing tuberculation and, therewith, markedly lower rates of flow capacity depreciation. From such revelations, it had been clear that the inherent value of protective linings and chemical treatment to insure added life-capacity had only recently begun to be recognized. Bituminous enamels of today had been so modified by processing coal tar pitch as to render them the equal of asphalt in respect to physical qualities (sag, adhesion and cracking) and superior in respect to being less water absorptive and longer lived. Based on the 20 year service record in a New York City conduit, dependability of coal tar coatings seemed assured.

Following the moving picture, questions brought on explanations of tapping procedure on lined and coated thin walled steel pipe, and later a display of sections of factory coated and lined pipes. There were other pipe sections to illustrate the use of expanding bushings, or rings, of lead around the threaded end of corporation cocks, machine inserted in slightly oversized threaded holes, none of the operations proving damaging to the surrounding lining. In summarizing, Mr. Thwaits listed the attributes of modern lined and coated steel pipes to be, toughness, flexibility, light weight, predictable long service life, long lengths for economy of installation and jointing with bottle tight and flexible mechanical couplings, which were simple to install and dependable.

"The New Sand-Wash Brook Dam and Reservoir at Pittsfield, Mass.," by SAMUEL M. ELLSWORTH, Consulting Engineer, Boston, Mass.

Aided by lantern slides, Mr. Ellsworth presented a description of the new reservoir and dam, constructed as an additional supply for Pittsfield. Involved was an interesting aerator at the base of the earth-fill dam with concrete core wall. It consists of a 42 ft. diameter ring of cast iron pipe (see cut) equipped with spray nozzles supplied from the gate-house having but two level take-off inlets. Concerning studies to determine the optimum water content of the fill material, to secure minimum seepage, revealed such to be 13 to 15 per cent and not far above the natural water content of the material as taken from borrow pits close at hand. With 8 inch layer applications, sheep-foot rollers with little sprinkling (mostly for lump breaking) produced optimum density of fill at a density of 135 lbs. to the cubic foot. Illustrated, were the moisture study curves and equipment and method of sampling sections in the control of compacting operations. The $250,900 project was financed through a P.W.A. grant netting Pittsfield $158,000 for a reservoir costing only $226,000 per M.G.D. yield.

"Micro Movies" proved to be the outstanding film, showing "intimate" views of the life habits of fresh water plankton, which required the perseverence, time, and hobby interest of Major John B. Hawley, Consulting Engineer, Fort Worth, Texas, in its production. The copy of the film shown is the property of Harry J. Krum, City Chemist of Allentown, Pa., and was loaned by him. A running explanation of the pictures was given by Professor Melville C. Whipple of Harvard University, who has the reputation of knowing each "trained flea" in the Major's "Carnival of the Cyclops" by his (or her) first name.

(To any group of water works or sewerage men who have not seen this remarkable movie of fresh water and sewage biology, we take this opportunity of recommending its showing for an hour of interesting revelation. —Ed.)

Forthcoming N.E.W.W.A. Winter Meetings have been scheduled for January 20th and February 17, at Hotel Statler, in Boston, Mass.

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Long Island Operators Hold Another Circuit Meeting

The Long Island Section of the New York State Sewage Words Association, restricted to sewage works managers, operators and engineers, was established for the purpose of holding half day bi-monthly meetings on the circuit plan primarily, for the benefit of operators. The plan is to select a circuit of plants as gathering places. Following the plant inspection, a dinner is held and thereafter the technical session. The Section has a regularly elected secretary-treasurer and three member governing board, but no other officers. The Chairman of each meeting is automatically the superintendent or chief operator of the plant serving the community in which the meeting is held. Head table guests are the Sewerage Commissioner or Commissioner of Works, Trustees of the Sewer District, and usually the Mayor or Town Manager.

That the scheme has been a most successful one can be attested by the marked growth of the parent N. Y. State Association in members from the Long Island area.

The December meeting place was at the Cedarhurst, L. I., Treatment Works. Following the inspection and "back-fence" talk amongst operators dinner was served at the nearby Lawrence Country Club, where Mayor Eldred met 75 earnest members of the Section, heard what they talked about, and learned that Cedarhurst's plant superintendent—Wm. J. Hogan—knew how to conduct a meeting, as well as operate the local sewage works. Also, had Supt. Hogan brought with him the four trustees of Cedarhurst's Sewer District and his immediate boss—W. D. Reilly, Commissioner of Works.

Then followed the business session and technical program. The first paper by George E. Henkel, Engr. in Charge of the Jamaica Bay plant of New York City, dealt with "Chlorination at the Jamaica Plant" in an outstanding operator's paper, which received high praise as to preparation and presentation. Discussion was contributed by three other superintendents of New York City plants at which chlorination is employed—Daniel B. Keehan (26th Ward Brooklyn Plant), Emil Erdwun (Queen's Plant), John Fernandez (Coney Island Plant).

The second paper was that of Dr. Anthony Fischer, Research Chemist of the Dorr Co., which dealt with the features of "Two Stage Sludge Digestion," in which the advantages of two-stage over single stage digestion were set forth. Discussion was presented by Fred Biele, Consulting Engineer of Huntington, L. I., now Vice-President of the Association; and Carroll McLaughlin, Consulting Engineer, of Hempstead, L. I.

In the business session, Secretary and "wheel-horse" Lawrence L. Luther, Supt. of Works of Freeport, L. I., was re-elected with acclaim. To the Governing Board, Wellington Donaldson, Engr. in Charge of Sewage Treatment, New York City, and one of the organizers of the Section, was unanimously re-elected to the Board for a three year term.

The next meeting will be held in March, the place to be selected by the Board.

POWER PRODUCTION FROM SLUDGE GAS

Experiences During 8387 Hours of Operation at Cedar Rapids, Iowa

By JOHN C. McINTYRE

Supt. Treatment Works,
Cedar Rapids, Iowa

IN October, 1935, the sludge gas engine at the Cedar Rapids Sewage Treatment Plant was put in operation. In order to simplify future yearly reports the city fiscal year of April 1, 1936, to March 31, 1937, was selected as the first annual report on engine performance and costs.

Before going into the performance and cost data a brief description of the gas collection system and the engine-generator arrangement will be given.

The Digestors

Sludge is digested in four tanks each 60 feet in diameter and 27 feet deep. Gas is collected from three of these digestors. Two are equipped with P.F.T. floating covers, one having a 60,000 cubic feet gas-holder cover. The fourth digestor is open and is used merely as a storage tank. The three covered tanks are heated by circulating the cooling water from the gas engine at a rate of 80 g.p.m. through the digestor coils.

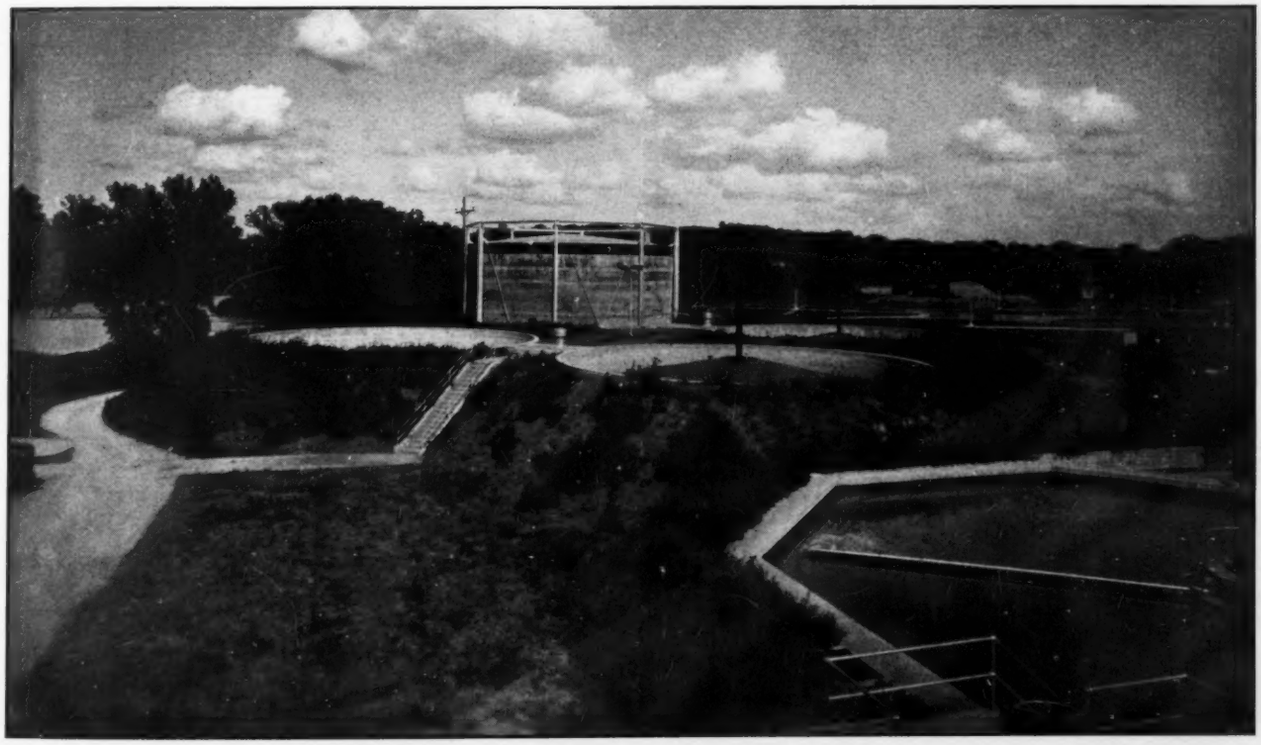
The gas is metered from each digestor and pumped either direct into the 6 inch feeder main or into the gas holder. The weight of the gas holder cover keeps the gas pressure at approximately 0.22 pounds per square inch, at which pressure it is utilized in the engine. A home made gas scrubber for the removal of hydrogen sulphide is installed on the engine fuel line. Up to the present time sulphides in the unfiltered gas have been very low averaging .005 grains of sulfur per 100 cubic feet of gas.

The Power Plant

The power plant consists of a Worthington 4 cycle, 5 cylinder, 210 H.P. engine driving a G.E. 187 KVA, 2,300 volt generator at a speed of 300 r.p.m. The exhaust from the engine is carried through a waste heat boiler through which the circulating water for the digestor heating may be pumped. The waste heat boiler is needed only during the winter months when the raw sludge and the atmosphere are quite cold. Outside the building the exhaust goes through a 10 in. Maxim silencer.

The power generated is connected directly to the Power Company's bus bars in the main building of the treatment plant. The electrical controls are so arranged and metered that the power generated may all be utilized by the treatment plant; all or part of it added to the Power Company's system; or, all or part of the treatment plant demand may be taken from the Power Company's line. Any of these conditions may be taken care of without any interruption in operation within the treatment plant. By an agreement with the Power Company they agreed to buy all the power that we are able to add to their system.

The engine is started on compressed air carried at 175 pounds pressure. As the engine comes up to speed, voltage builds up on the exciter, supplying current to start the series of automatic steps required to synchronize the generator with the line characteristics of the Power Company's feeder line. When this series of steps is



Digestors and Gas Collection System, Cedar Rapids, Iowa. Two Digestors Have Floating Covers, One a 60,000 Ft. Gas Storing Cover, One Serves for Sludge Storage.

Cedar Rapids Treatment Works. Administration and Pump Building on Left; Power Plant on Right.

completed the desired load may be applied to the generator.

In the control system are arranged engine shut down devices which close the fuel valve, shut off the ignition and sound an alarm. This goes into play when the engine overspeeds, or the oil or water temperatures are excessive, or the oil or water pressure is low, or the bearings become overheated or the generator over heats, or the voltage or current becomes too high; and also when the field current on the generator drops.

A more complete description of the treatment plant may be found in Sewage Works Journal 1936, Vol. VIII, pages 448-455, and WATER WORKS AND SEWERAGE for July, 1937.

Cost of Installation

Now will be cited the cost of installation and operating costs, in an effort to show the value of the gas engine-generator set to the city of Cedar Rapids.

The cost of the complete installation was $26,900, of which amount the Government grant under PWA was 30 per cent, leaving $18,830 as the cost to the city. To this must be added the difference in cost between the 60,000 cubic foot gas holder type digester cover and the conventional type floating cover. This cost was $2,500. Deducting the Government grant of 30 per cent leaves $1,750 as the amount paid by the city. After the installation was completed it was decided to install a gas scrubber and an oil reclaimer. These extra items amounted to $621.62 which must be added to the capital cost. The sum of these three amounts total $21,201.62 which represents the cost to the city of Cedar Rapids.

Annual Charge

With money available at 4 per cent interest and assuming the life of the engine-generator to be 15 years, which is considered a fair term of service, the annual charge is computed. This 15 years service may be somewhat severe since the engine and generator both would have some salvage value at the end of their useful life, and that value is not considered in this cost report. Other items that are not given consideration are cost of housing, since it is hard to arrive at a fair charge for housing one piece of equipment when it is installed in a building containing other equipment. The generator control panel and switch gear as installed are adequate for another generator so this credit due the engine generator will go to help offset the cost of housing.

We know from our records that the cost of the oil for the year was $648.89, and $383.49 was spent for repairs and spare parts. Of the amount spent for repairs $266.23 went for spare parts that have never been used, but will be charged against the operating cost for this year.

The cost of maintenance labor is estimated at 1 man hour per day at 75 cents. No employes in addition to the regular treatment plant employes are needed to care for the engine-generator set, since all the attention normally required is for oiling and checking.

TABLE I—Annual Charge

Interest on $21,201.62 @ 4%	$ 848.06
Sinking fund @ 4% (cost retired in 15 years)	1058.81
Repairs and replacements	383.49
Lubricating oil and grease	648.89
Labor	273.75
Total Annual Charge	$3213.00

Annual Saving

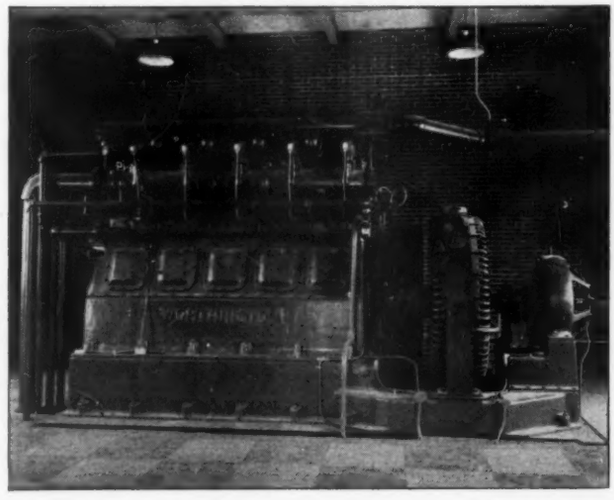
As a basis for the annual savings, we will assume that the treatment plant had no engine-generator, and the power was paid for at the present contract rate and the power consumption was the actual power used during the year in the treatment process. We know from our records the amount of power used by the plant was 732,875 K.W.H., with a demand charge on 150 K.V.A. over each monthly period. The city paid the Power Company $2,668.80 of which amount $1,020.00 represents a ready to serve charge and must be paid every year, whether or not any power is used.. The Power Company paid the city $751.42 for power turned back to their system.

TABLE II—Annual Saving

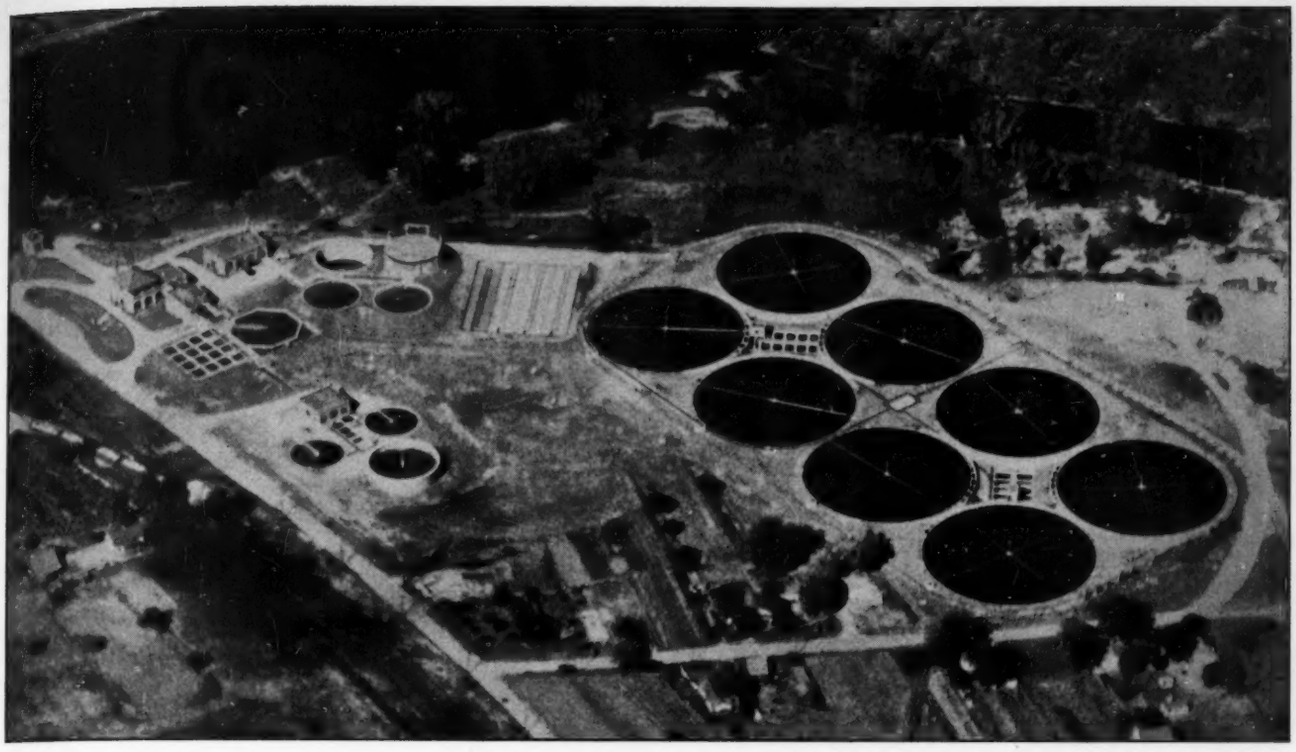
Value of power used at power company rate	$10,950.00
Actually paid power company	2,668.80
Saving with no sale of power	$ 8,281.20
Income from sale of power	751.42
Gross saving in cost of power	$ 9,032.62
Annual charge against engine from Table 1	3,213.00
Net saving to city for the year	$ 5,819.62

Performance

The engine-generator set was operated 8,387 hours during the year. In July a thorough cleaning and inspection of the engine kept it shut down for 240 hours. During this period the pistons were pulled out and cleaned up, all the rings were found to be in proper working condition. The crank and main bearings were inspected and adjusted. One main bearing was showing indications of excessive wear and was replaced. During November a leak developed in the gas collection line in



The Engine-Generator Set, Cedar Rapids. A Worthington 5-Cylinder 210-h.p. Engine and "G-E" 187 k.v.a. 2,300 Volt Generator at 300 p.p.m.



The Combination Wastes Treatment Plant of Cedar Rapids, Iowa. (Treats Packing Plant Wastes and Domestic Sewage.)

one digestor causing an interruption in the engine operation for 30 hours. The balance of the time out of service was for minor adjustments and inspections.

It has been found that the oil in the crank case should be changed after every 340 hours of operation, to prevent an excessive building up of acidity. A three-way by-pass valve was installed on the oil pressure line enabling us to change the oil without stopping the engine. The oil thus drained is purified in an "Ames" Oil Reclaimer and used over again. This oil reclaimer using an alkaline filtering media, reduces the acidity and removes the water and other impurities, giving us an oil that will meet the specifications of new oil.

A spare set of inlet and exhaust valves simplify the valve changing and grinding duties, which we have found to be necessary about every four months. The overhead valves in one cylinder can be removed, the spare set put in place and the engine placed back in operation in 15 minutes. The valves thus removed are ground and then used to replace those in the next cylinder.

The following table gives further performance and operating data.

TABLE III

Average KWH generated per day	2,940
Per cent of rated capacity	82
Hours in service	8,387
Per cent of time in service	95
Total cost per KWH from Table I	.0029
BTU per KWH	16,200
BTU per BHPH	9,940
BTU recovered per day for digestor heating	9,608,000
Gals. oil added per 1,000 HPH	0.5
Average oil temperature, deg. F	120
Average hot water temperature, deg. F	130
Average return water temperature, deg. F	115
Average exhaust temperature, deg. F	930

Summary and Conclusions

After a year's operation we find that the engine-generator power plant has given very satisfactory service operating on sewage sludge gas.

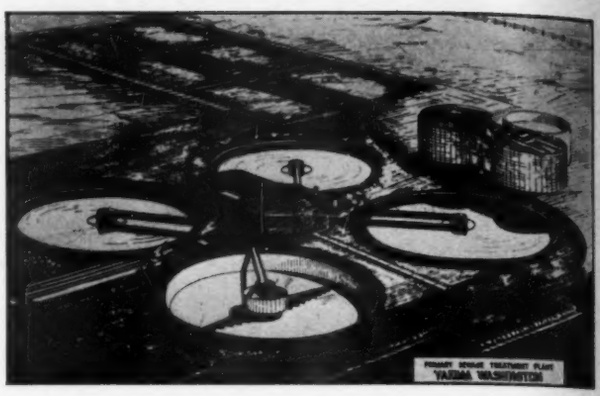
During normal operation of the treatment plant we can generate enough power to carry the plant and in addition turn a small amount of power into the Power Company's system.

During extended rainy periods, or when the river is at flood stage, the power demand of the raw sewage pumps alone has been as high as 330 KVA. This maximum demand must be provided for in our power arrangement, as a considerable part of the business district and part of the residential district depend upon the raw sewage pumps to keep the sewage from backing up the sewers into their basements when the river is at flood stage. An average sanitary sewage flow of 7 MGD has gone as high as 34MGD during flood stage, due to infiltration and river water running in through basement walls and windows and down the basement drain into the sanitary sewers. All this flow must be pumped.

In a treatment plant where the gas production is ample and where the flood sewage flow need not be pumped I can see no reason why the plant cannot develop enough power to meet its requirements. Such a plant, however, should provide for a stand-by unit operating on gas as well as some other type fuel. This type of stand-by engine would take care of any unexpected interruption in the sludge gas supply. Considering the fairly low stand-by charge paid the Power Company here in Cedar Rapids, and also that we must provide for a power demand of 330 KVA, we cannot justify an expenditure large enough to equip the plant with stand-by power units to supply this demand.

However, we are well pleased with the operation and the savings effected with the one power unit included in the sewage treatment system for Cedar Rapids.

Acknowledgment must be given Mr. F. E. Young, City Engineer, under whose supervision the plant is operated, for access to cost records, to Mr. H. R. Green, Consulting Engineer, who designed the treatment plant, and to the Iowa Light & Power Company for their co-operation at all times.



Sketch of Yakima's New Treatment Works (Stevens & Koon, Engineers)

YAKIMA'S NEW SEWAGE DISPOSAL PLANT

To Handle Flows of 4 to 20 MGD the Problem

By A. W. VON STRUVE

Section Chief, Works Progress Administration, Washington, D. C.

THE city of Yakima, Washington, is about eighty-five miles above the mouth of the Yakima River where it empties into the Columbia. Between Yakima and the mouth of the river are many towns and rural communities depending upon irrigation. These cities and towns, located down the river from Yakima, have, at various times in the past, threatened to bring suit against the city for sewage pollution of the river. At one time these lawsuits, if consummated, would have amounted to over one million dollars.

Several years ago the city officials of Yakima realized it was imperative that a modern sewage disposal plant be constructed so as to eliminate the serious health hazard to neighbor communities on the river below Yakima. The cost of such a plant proved prohibitive, without over-bonding the city for a considerable sum. Now, with the assistance of the Works Progress Administration, a sewage disposal plant has been made possible of construction by the city of Yakima.

In the past few years the city of Yakima has added one hundred and eighty-seven acres to the incorporated limits of the city. This rapid growth has added many new consumers on the city owned water system, thereby materially increasing the revenues of the Water Department. The operation and maintenance of the Sewage Disposal Plant has been placed under the jurisdiction of the Water Department and, as a result, the citizens will not be required to pay for the plant by the issuance of general obligation bonds. The operation and maintenance costs of the type of plant for Yakima are small, and will not add a great burden on to the Water Department. In short, Yakima has solved its sewage disposal problem for years to come without creating an undue burden on its citizens.

The Plan

The sewage is taken to the plant through a forty-eight inch sewer, of concrete pipe construction, to the entrance channel which is four feet wide and is provided with an emergency overflow by-pass weir. The flows are measured and recorded through a Parshall flume beyond which are the grit separating channels. The grit channels are cleaned by discharging grit through the bottoms into a small car operated on a track extending to a grit dump. The sewage, after leaving the grit channels, passes through two twenty-five inch "Comminutors" and is distributed to four channels, each of which leads to a separate clarifier (see sketch).

These clarification units, constructed as a chamber, are each ninety feet in diameter with eight feet side water depth. In the center is a building which contains the sludge pumps, heating plant, and controlling mechanisms, recording devices, chlorinating equipment, laboratory, etc. At the rear of this building is a platform for the storage of chlorine. One of the clarifiers can be utilized during the chlorinating season as a retention basin for chlorination of effluent. When required as an additional clarification unit prechlorination ahead of all clarifiers can be had.

There are two sludge digestion tanks, and a third tank for sludge storage. The sludge from the storage tank or digesters flows by gravity to open sludge drying beds. There are six such beds, each fifty by one hundred feet in size. The plant is designed to treat flows of from 4 MGD. in winter up to 20 MGD. in summer. The marked variation between the summer and winter sewage flow is due to the great amount of irrigation in the valley which results in an exceptional degree of infiltration into the sewer system.

As of October 1st, with the plant 98 per cent completed, the Federal Government had expended $130,392.66 for labor. The materials and other direct costs amounted to $29,778.55, or a total of $160,171.21. To date the sponsor has contributed $113,663.98 and the plant is now in actual operation, only a few minor adjustments being necessary.

The contracts for the clarifier and digester equipment were let to The Dorr Company. The plant design and supervision of construction was under the direction of Stevens and Koon, Consulting Engineers of Portland, Oregon, in cooperation with A. B. Collins, City Engineer.

Effectiveness "ONE PICTURE IS AS GOOD AS A THOUSAND WORDS"

This statement is attributed to the Chinese and indicates that we are more quickly impressed by what we see than by what we read. This "NUCHAR" illustration is a further attempt to connect the application of NUCHAR to water.

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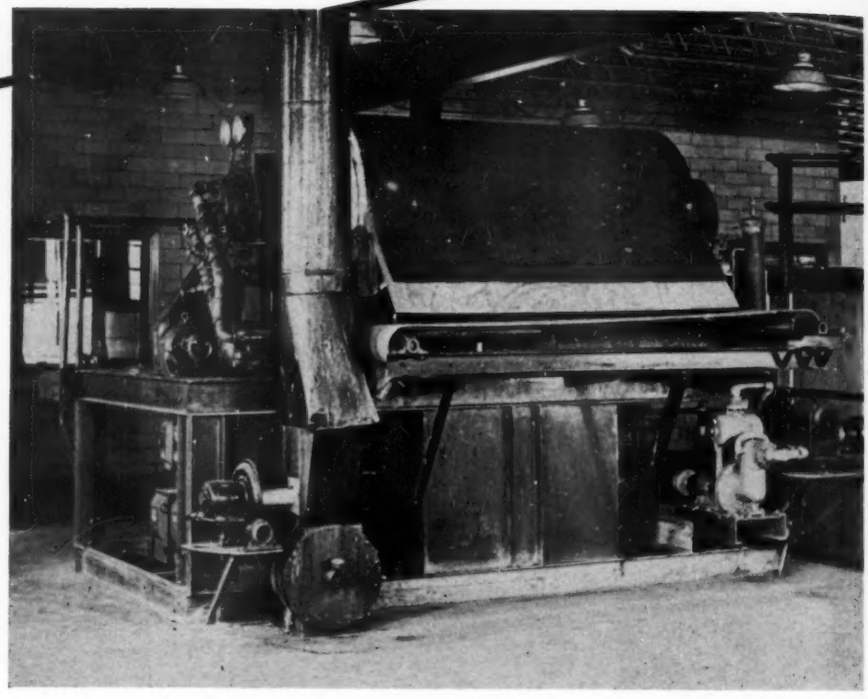

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ALL-ASSEMBLED SLUDGE DEWATERER

This message is addressed particularly to the communities with less than 2 mgd flow desiring to install the most modern, most practical method of dewatering sewage sludges.

Such communities should look into the merits of the small All-Assembled Oliver Sludge Dewaterer which has recently been purchased by several small cities and a State Institution, and which is already operating in a number of places. It is adaptable to all classes of sludge.

The All-Assembled Oliver Dewaterer unit is in effect a miniature sludge conditioner and filtering plant set compactly on a platform. It is shipped all-assembled. It is installed all-assembled. After setting it on the floor in the filter room little has to be done to have it ready for work.

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WHAT IS NEW IN METERING*

By JOHN R. HARTLEY

Asst. Engineer, Builders Iron Foundry, Providence, R. I.

The Kennison Nozzle

THE Kennison nozzle is new. It is the invention of Karl R. Kennison, of the Metropolitan District Water Commission of Boston.

Fig. 1 is a diagrammatic view of a typical installation of the Kennison Nozzle. This shows quite clearly the installation of a nozzle at the end of the pipe line discharging into a basin or sump, to obtain free discharge. There is a single piezometer connection at the bottom of the nozzle near the upstream flange, and this is connected to a large float pipe. Any ordinary mechanical instrument can be operated with the Kennison Nozzle, using a single float with cable and counterweight. It is also adaptable to remote transmission using standard Chronoflo Meter Units. In all cases, the instrument dials have uniformly spaced graduations which are obtained by means of a specially shaped cam in the instrument.

Fig. 2 is a typical calibration graph showing the relation between float travel (or head) and rate of flow. The characteristic curve is similar to that obtained with a weir. At rates from 25 per cent to 100 per cent of maximum, the curve is practically a straight line with linear relation between head and rate. At the low rates, the curve departs from a straight line, but as in the case of a weir, the departure is just the opposite of that obtained with the Venturi and other differential primary units. In other words, we have large increments of head for small changes in rate instead of vice versa.

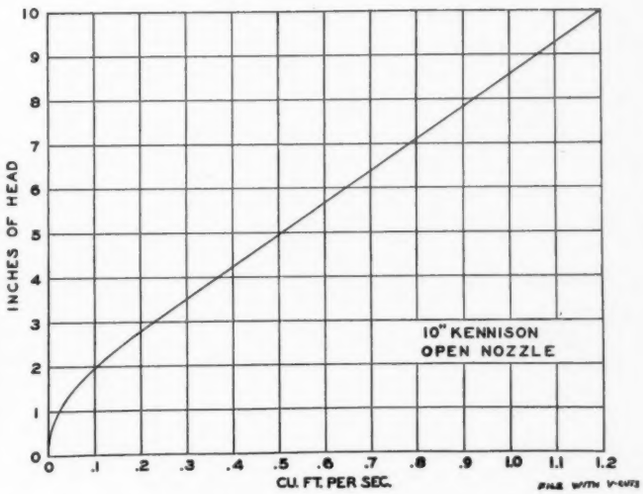

Fig. 2—A Typical Calibration Graph of the Kennison Nozzle. Note Large Head Increment for Low Flow Changes.

Usually, the question of loss of head does not come up in connection with one of these installations because the nozzle is used only for free discharge into an open tank or basin. It is correct to say, however, that the loss of head would not be more than equal to the diameter of the pipe, i.e., with a 12 in. line, the loss of head would be about 1 ft. maximum, in which case the level in the basin would be just about even with the bottom of the nozzle. The nozzle is not intended to operate while submerged.

In addition to low loss of head, the Kennison Nozzle has numerous other advantages, some of which are obvious. It is open at the end, with no obstruction to the flow; therefore, sewage sludge and other liquids carrying suspended solids and trash can be readily measured. The nozzle is accessible for easy cleaning. As far as can be determined from the installations in service and laboratory tests, it has an extremely wide measuring range, probably 20 to 1 or better. In fact, three of the nozzles now in service for the Metropolitan District Commission in Massachusetts have shown good sensitivity to variations in rate of flow, even below 1/20th of the maximum rate.

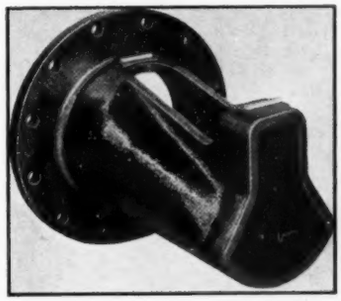

Fig. 3—A 10-in. Kennison Nozzle.

Fig. 3 shows a 10 in. Kennison Nozzle built for measuring sludge at the new Columbus, Ohio, Sewage Treatment Plant. The light-colored bars across the top of the nozzle at two points (front and rear) are used for leveling purposes. The bottom or invert of the nozzle is laid on a very small slope for drainage.

*A paper presented before the Virginia Section of the American Water Works Association by Alan A. Wood, of Builders Iron Foundry. Here presented by permission of the Secretary and Editor of the Association.

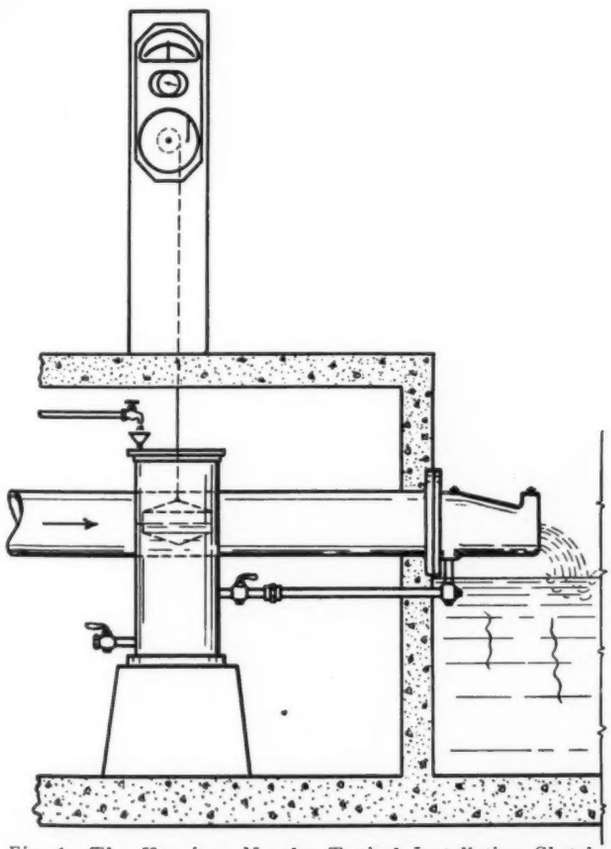

Fig. 1—The Kennison Nozzle—Typical Installation Sketch.

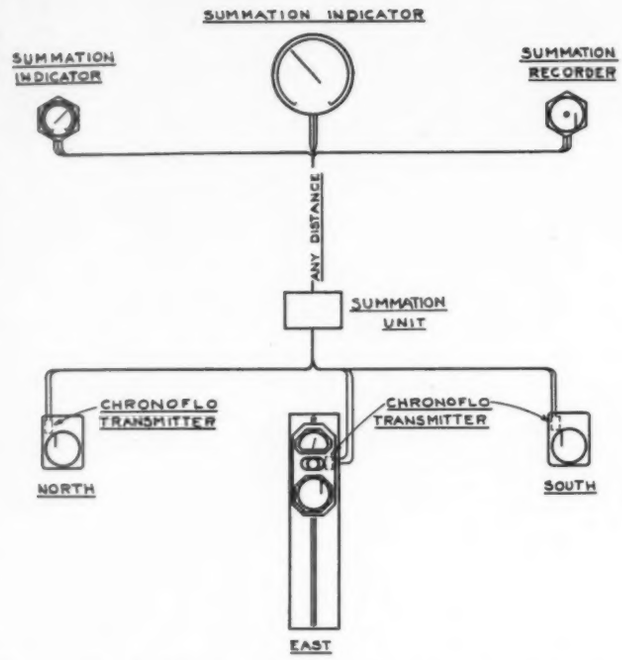

Fig. 4—Sketch Showing Arrangement of Various Units Connected to the Chronoflo Summation Gauge

Chronoflo Summation Gauge

The Chronoflo Summation Gauge is based on the Chronoflo Meter Transmission System. There is a Chronoflo Transmitter connected with each individual meter from which readings are to be added or totalized. Fig. 4 shows diagrammatically how the various units are arranged in relation to each other. There are three meters, North, West and South, each having its own individual transmitter. Readings from these transmitters are carried over a pair of wires to the Chronoflo Summation Unit which is a unique motor-operated relay and selector switch. This summation relay takes a reading from each of the three meters, in sequence, and passes these readings on to the summation gauges which may be indicating, recording or totalizing. For instance, the large summation indicator at the upper center of the drawing will receive three signals during each cycle. The first signal from say the North meter, the second signal from the West meter and the third signal from the South meter. The summation reading is a function of the three signals which are received. This same method of operation can be applied to any number of units.

Remote Pumping Station Control

This is shown in Fig. 5 which has been sketched to represent the recent installation at Oklahoma City. The main purpose is the control of an electrically-operated pumping station from a remote point, which is usually a central office, and at which there is an attendant on duty at all times. This scheme eliminates additional help or attendants at each remote pumping station.

The layout shown on the drawing includes two Chronoflo meters, one for level and the other for flow. These are in continuous operation and utilize one wire each for transmission, with ground return.

An important unit in this scheme of operation is the selector dial shown on both control panels. This is just the same as an ordinary telephone dial and is used to control the operation of the pump, valve and any other units desired. Instead of dialing a series of numbers, it is necessary to dial only one number and this will connect with the desired circuit at the remote point. For instance, to start the pump, dial one (1); to stop the pump, dial two (2); to open the valve, dial three (3), etc. Only one wire, with ground return, is required for this dialing system.

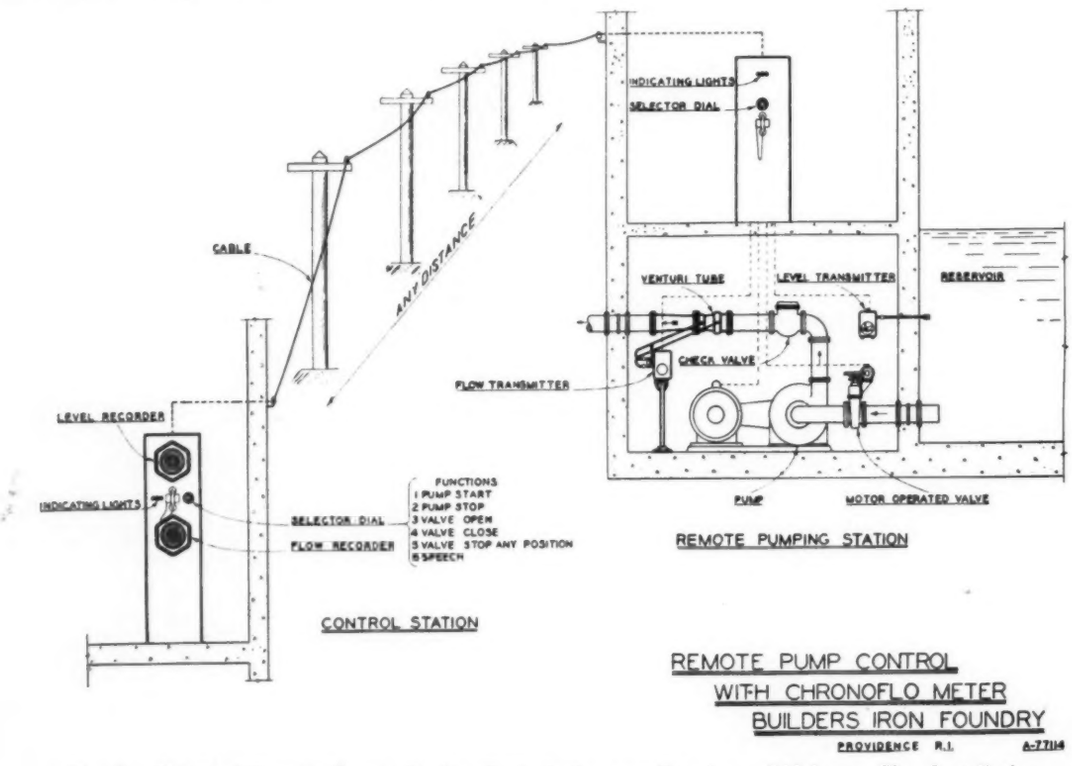

Fig. 5—Sketch of Remote Pump Station Control System—Based on Oklahoma City Installation.

The control panels have indicating lights which show (a) operation of pump, say green when pump is running; (b) position of valve; red—valve closed; amber—valve opened; both lights—valve in intermediate position.

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MISSOURI VALLEY SECTION HOLDS 23RD ANNUAL MEETING IN OMAHA

FROM Missouri, Kansas, Iowa, Nebraska, and eastern South Dakota, came water-works operators, peddlers, professors and engineers to Omaha, Nebraska, on November 4th and 5th, 1937, to attend the 23rd Annual Meeting of the Missouri Valley Section of A.W.W.A. An attendance of over 250 indicated the interest of waterworks men in problems peculiar to their portion of the country.

On Saturday, November 6th, the meeting was transported in special buses to the new iron and manganese plant of the City of Lincoln, Nebraska, where host Dave L. Erickson, City Engr., served luncheon. Thence to Lincoln to see the Kansas-Nebraska football game.

As evidence of the keen interest in water works problems, it was noted that every paper on the program was presented by the author in forum and then discussion indulged in. The Metropolitan Utilities District of Omaha, under the leadership of Col. Theodore A. Leisen, retiring Section Director of A.W.W.A., and local Chairman John C. Detweiler were hosts to the convention and sponsored an inspection trip and delightful lunch at the Florence Pumping Station and Filtration Plant. Perfect weather prevailed and attendance at the convention was excellent throughout.

Newly elected officers were:

Chairman: Dale L. Maffitt, Manager Water Board, Des Moines, Iowa.

Vice-Chairman: Bernard L. Ulrich, Superintendent, Water Department, Manhattan, Kansas.

A.W.W.A. Director: Earle L. Waterman, University of Iowa, Iowa City, Iowa.

Trustees

Kansas, F. A. Rafford (Junction City); Nebraska, Lee Nelson (Hastings); Iowa, Charles Alexander (Ames); Missouri, Clarence Hoen (Carthage); South Dakota, E. R. Matthews (Aberdeen).

Selection of meeting place and secretary to succeed Mr. Waterman was left to the executive committee.

Technical Sessions

(Chairman N. T. Veatch—Presiding)

The opening paper, **"Operation Problems at the Omaha Water Treatment Plant,"** was presented by F. B. LASELL, Chief Chemist of the Metropolitan Utilities District, Omaha. Methods of handling excessive turbidities (about 32,000 p.p.m.) involving problems in coagulation, settling and filtration were described. Plant improvements were indicated in 1930 when normal 48 mgd. filters had to be operated at 60 mgd. rates for a short time. Basin and flume improvements were made to allow periodic sludge removal by opening flushing valves which permits continuous basin operation without unduly disturbing sedimentation. Parallel, rather than series, operation proved more satisfactory in clarification. Additional filter units were added to bring the plant to 72 mgd. normal capacity. New conduits have been added to reduce velocity and preserve alum floc. Relief labor was used in salvaging abandoned suction lines and relocating piping about the plant when old steam pumping equipment was replaced by electric units to save a large expenditure for increased boiler capacity, steam turbines, etc. Basins at the Florence Plant are 32 to 35 ft. deep and three 12-in. flushing valves, spaced 60 to 70 ft. apart adequately remove the mud when opened for 5 minutes daily during spring and summer. Coarse bar screens protect the low lift pumps, which take water from the Missouri River above the city and discharge into sedimentation basins. Alum, manufactured at the filter plant, is used as the coagulant. Electric power is now used throughout, with the steam plant kept in reserve. Water is pumped to open distribution reservoirs and repumped to serve high level areas. In 1936 the average daily per capita consumption was 140 gallons.

N. T. Veatch, Cons. Engr., (Kansas City) Retiring Chairman

Dale L. Maffitt, Mgr. (Des Moines, Ia.) New Chairman

B. L. Ulrich, Supt. (Manhattan, Kan.) Vice Chairman

Col. T. A. Leisen, Mgr. (Omaha, Neb.) Director, A. W. W. A.

On behalf of the Metropolitan Utilities District the Convention was welcomed by Allen C. Tulsey, Chairman of the Board of Directors. City Attorney, Sewmoure Smith, added the greetings of City of Omaha Administration. Chairman N. T. Veatch responded on behalf of the Missouri Valley Section recalling very pleasant previous meetings in Omaha.

A. W. W. A. Marches On!

HARRY JORDAN, genial secretary of A.W.W.A. took his subject—**"A.W.W.A. Marches On!"**—literally and outlined to the convention the work of the Association through various committees and memberships on committees of inter-related organizations. He recalled the birth place of the A.W.W.A.—the Engineers Hall of Washington University in St. Louis, where a handful of water works men from Keokuk, Iowa, and points along the Big Muddy and Father of Waters got together

NOTE: This report, prepared for our December issue, was unavoidably held out at the last minute. We regret the necessity of such postponement and, herewith, our apologies to officials and members of the Missouri Valley Section.—ED.

Prof. Earl L. Waterman
(University of Iowa)
New National Director
A. W. W. A.

C. S. Timanus
(Kansas City)
Burns and
McDonald, Engrs.

more than 50 years ago to exchange ideas, discuss problems, etc. Mr. Jordan gave an account of his stewardship for 11 months and cited projects under consideration by the 68 A.W.W.A. committees now at work. He cited that the new Manual of Water Purification was in the immediate offing and several new "standard specifications," such as for cast iron pipe, etc., were nearly ready for release. Discussion of committee action—or lack of it—was given by Mr. Shaw, U. S. Public Health Service, Chicago; Dean F. M. Dawson, Iowa City, Iowa; W. W. DeBerard, Engineering News Record, Chicago; Paul Hansen, Consulting Engineer, Chicago. It was suggested that the Association call important committee meetings once a year and pay the expense of members to the meeting in order to facilitate action. The policy of the A.W.W.A. in meeting only at hotels where the sanitary facilities were approved by the State Health Department was commended. Rigid adherence should not be relaxed.

More Papers

The afternoon session opened with a paper by J. C. TRACY of Permutit Company on **"Water Softening and Iron Removal."** He confined his remarks to the use of zeolites. Mr. Tracy showed that the mineral could be used indefinitely and that regeneration time of from 30 to 60 min. was effective. Modern municipal zeolite plants are fully automatic through a master multiport valve and electrical timing devices. Effluents of any desired hardness may be obtained by bypassing desired amounts of raw water or operating at higher filtration rates. Iron and manganese, where present in carbonate form, are removed as the water is softened. A special iron-manganese zeolite, which does not soften water, is used to remove such from the bypassed hard water. Potassium permanganate is used to regenerate this zeolite. The natural zeolites (green-sands) are not affected by iron or managanese deposits. Mr. Tracy showed numerous slides of pressure and gravity type filters and called attention to the absence of a sludge problem which exists at lime-soda plants.

E. B. BLACK, Consulting Engineer, Kansas City, discussed **"Rates, Valuation and Water Ordinances."** In mentioning the use of "yardsticks" in present-day practices, he stated that numerous cases already decided in the courts, or by commissions, have given the formula that the return from public utility operations should be sufficient to return to the owners all operation costs, maintenance, depreciation and a fair return on invested capital. There was no substantial difference between the basis on which rates for privately owned and municipally owned waterworks utilities should be fixed. A Kansas enactment provides for the establishment of Utility Boards to manage and operate municipally owned utilities, wholly outside the authority of the city governing body. Municipal plants should have reserve funds available for various purposes, without waiting for the taxpayers to provide funds through bond issues. On the other hand, most revenue bond legislation, providing for the building of water utilities or providing betterments out of revenues derived wholly from rates constituted an unwarranted raid on the rate payer. The diversion of funds of water and light utilities Mr. Black scored. Concerning valuations: in years past such had been based on the cost of reproduction (less depreciation) and included such general items as going value, interest during construction, engineering and legal services during construction, etc. In Kansas, he said, a system of classified accounts was about to be installed in all municipal plants and, therewith, proper engineering valuation and satisfactory accounting practice must be made. Water ordinances regarding private fire hydrants, rental and inspection of sprinkler systems and regulation of the use of private well water for cooling purposes were discussed. It was stressed that payment should be made for the service rendered, and that rates charged should not be below the cost of rendering such service. The policy of some cities in supplying water to industry at rates "below the cost of production and distribution" was scored.

Dean F. M. DAWSON and A. A. KALUISKI, of the University of Iowa, presented their paper on **"Control of Water Piping from Main to Consumer,"** and indicated the desirability of having proper control of the water from source to consumer. Piping in buildings have been a neglected part and weak link in the protection of the health of citizens from water borne disease. Cross connections and back siphonage are well known but 90 per cent of all vacuum formations in pipelines could be eliminated if properly sized. Building pipes should be

Attending the Meeting

1. *Dave L. Erickson, Mgr. Public Works, Lincoln Neb. (Luncheon Host).* 2. *John C. Detweiler, Engr., Omaha Utilities Distr. (Had Charge of Local Arrangements).* 3. *Chas. Alexander, Ames, Iowa (New Section Director).* 4. *V. B. Trueblooks, Mgr. Water Board, Waterloo, Ia..* 5. *L. W. Helmreich, Mgr. City Water Co., Jefferson City, Mo.* 6. *Frank Willey, Supt. of Water, Lawrence, Kans.*

tested after installed to see if proper pressures are maintained when ordinary usage is encountered. Cooperation between health and water control authorities is needed if more than one authority has jurisdiction of water from source to consumer taps. Air conditioning brings new problems. Regulation, inspection, and testing, by properly trained authority was needed to insure the safe quality of water from source to consumer. The recent amendment to the Wisconsin Plumbing Code was cited.

Slime and Algae Control

"Chemical Methods in Slime and Algae Control," was presented by H. K. NASON, Monsanto Chemical Co., St. Louis, Mo. With air conditioning equipment, the slime problem becomes more important as algae and slime reduce heat transfer efficiencies. Present-day control measures with copper sulphate, mercury and chlorine compounds were reviewed. Ammonia-chlorine is an important control and copper in conjunction is effective. New synthetic compounds of chlorine and phenols, (sodium pentacholorophenol) proved effective for industrial waters where taste is not a problem. The resistance of some algae and slimes to high dosages of copper and chlorine compounds was noted and the use of chlorine as the basis of control was indicated.

U. S. Pipe and Foundry Co. presented its moving picture on the **"Manufacture of Super de Lavaud Pipe,"** to close the first day's session. In the evening a stag smoker and buffet supper, with an excellent floor show, enlivened the group while the ladies were being entertained at a theatre party.

They Came, They Saw—But It Was a Tie

1. H. L. Brown, City Mgr. and E. W. Hopkins, City Engr., Salinas, Kans. (Came Up to See Kansas Tie Nebraska); 2. "Alemite" Birdsall (Chicago) and "Bentonite" Olin (Iowa City) "Floccing" together—it's natural. 3. "Big Steamer" Bill Birch (Chicago) with the Inevitable Seegar and H. V. Pedersen, Mgr., Marshalltown, Ia. Water Dept.

Comes Another Day

The second day's program started promptly on time with Professor H. L. OLIN, of the Chemical Engineering Dept., University of Iowa, presenting his paper on **"The Use of Colloidal Clays in Water Purification."** He cited numerous laboratory experiments in the use of "Bentonite," a volcanic residue found in Wyoming and Western South Dakota. The sodium "bentonite" employed has remarkable swelling properties and appeared to have a place in clarification processes. It now costs from $12 to $15 a ton. No practical application was given by the author.

"The Geology of the Ft. Dodge, Iowa, Water Supply," by A. C. TESTER, Assistant State Geologist, Iowa Geological Survey, University of Iowa, was next presented by means of maps, geologic charts, etc. The No. 18 well at Ft. Dodge, with a flow of 3000 g.p.m. at the surface, is the largest flowing well in Iowa, if not in the entire upper Missouri Valley. Nearby wells failed to give anything like the yield of this well. Core samples had been studied from this well and the geological strata identified. It apparently is just at a very sharp fault in rock of the Devonian age where a slip of about 350 feet has occurred. Wells within a few hundred feet do not give near these yields and water from them is of slightly harder nature. The well is drilled 1000 feet.

"The Fort Dodge Water System" was described by JOHN D. PRAY, Superintendent, and vividly illustrated by motion pictures in color. The plant consists of aeration, sedimentation and filtration. Natural head on the wells is used to discharge the water over a step aerator where iron is precipitated. The water is then settled in basins, designed for softening, and is filtered. The architectural features of the plant and landscaping, very excellently done, exemplify the modern trend in water plant design. The city also owns and operates a hydroelectric plant on the Des Moines River, which flows through the town. Power is interchanged with a local generating station privately owned.

The second afternoon there were two papers and a short business session, after which the annual dinner-dance was held. Professor J. W. HOWE, of the Institute of Hydraulics, University of Iowa, gave a paper on **"Iowa Precipitation Trends and Their Significance,"** indicating by slides the downward trend of rainfall in Iowa. Plotted records, for a 60-year period, show a very marked downward trend which has been almost on a 45-degree slope. It was suggested that recent records are more dependable and indicative of present conditions than long time records, because rainfall is decidedly lessening in Iowa. Illustrated charts demonstrated this feature.

C. S. TIMANUS, Hydraulic Engineer, Burns & McDonnell, Engineers, Kansas City, Mo., closed the session with his paper on the **"Practical Application of the Hardy-Cross Method in the Analysis of Water Distribution Systems,"** and illustrated it with slides showing results at Kalamazoo, Mich., Toledo and Cincinnati, Ohio. Considering that about 50 per cent of the plant value lies in the distribution system, too little scientific attention has been directed to its design and extension. Elevated storage has very rarely been adequately designed and recent hot summers developed inherent weaknesses in the pipe system of those cities. Old methods of analysis are tedious, long and not as accurate as desired. The Hardy-Cross analysis method, developed in 1936 at the University of Illinois, applies the principle of stresses in rigid frame structures to water pipe water works. Diagrammatic setups drawn to scale are helpful in analysis of the problem. By "cut and try" methods the systems are finally balanced and the work greatly simplified.

The Association adjourned after election of officers and adoption of resolutions. It was regretted that several of the "old timers" were unable to be present and telegrams of regret were sent to veterans Molis, Lawler, Carter and Andrews.

The Editor's Comments

Last Year—and This?

WHAT were the developments in the field of water supply during the year just ended? What is ahead for the year 1938?

The first question is ably answered by a qualified authority and a leading engineer, Louis R. Howson, in his review "Progress and Trends in Water Supply and Treatment During 1937," featured in this issue. The space alloted Mr. Howson's splendid review is greater than was scheduled. Even in the face of the author's invitation to do so, we found wielding of the reputed editorial blue-pencil a most difficult procedure because of the sparcity of material in the context other than meat, plus the quality of composition characteristic of the reviewer. We believe that our readers will agree with us in our decision to give Mr. Howson's review extra space required, at the expense of postponing other articles scheduled for this issue.

It is especially gratifying that Mr. Howson acknowledges, in behalf of the many engineers and operators who have benefited therefrom, the several worthy contributions and developments which have come out of Chicago's Experimental Filter Plant, to advance the art and science of water treatment. Also the debt owing this city which has, these several years, financed the experimentation under such capable directorship. Likewise, the credit given those in Chicago's Department of Water Supply who are responsible for the establishment of the experimental plant and release of developments therefrom for the benefit of designing engineers, operators and the water works profession of the world.

Especially significant were the developments in water treatment of 1937, involving higher perfection in pretreatment of waters and a determination to produce waters of higher purity and greater freedom from tastes and odors. Evidence of such is found in a more diversified application of coagulants; wider usage of oxidizing and safety enhancing prechlorination; cleaner sand beds; extended treatments, and studies thereof, to hold corrosion troubles to a minimum; the more careful routine watch of raw water quality for possible taste and odor troubles, and the more effective and economical application of taste prevention measures; the trend toward maintaining a cleaner and more nearly sterile distribution system through adaptation of chloramination, preferably the more economical procedure of chlorination followed by ammoniation. Illustrative of the value of taste prevention measures, is the attention being given this matter by privately owned water companies which involves routine taking of the odor threshold values at prescribed intervals daily. Illustrative of the importance attached to assured production of a pleasing product, are the improvements at Oshkosh and Neenah, Wis., in which granular carbon filters have been installed beyond the sand filters, to serve as a double safeguard in conjunction with powdered carbon used ahead of the filters, as the more economical material in routine prevention. The expensive granular carbon beds provide the safety factor to take care of troubles that may "slip up" on the operator during the "dog-watch" (well known to all operators as the trouble watch), or whenever the powdered carbon dosage has been trimmed to a too fine point, or possibly misjudged. In times of need the "mopper-up" granular carbon is ready for the job. When not needed, it is merely "idling," performing no work, suffering little or no depreciation in serviceable life. The interesting phase of this development is taste It is indeed impressive to look back over the several worthy contributions of the Chicago Experimental Filter Plant, which continues to turn out data useful in general and, specifically, that sought in the design of filtration plants of astronomical dimensions proposed for Chicago. prevention assurance, *first;* and, therewith, economy to the extent permissible with least costly procedures as shock absorbing methods.

Two significant and trend creating developments have been the construction of industrial water supplies by two Southern cities—Birmingham, Ala., and Charleston, S. C.—one to make possible a further industrial growth, the other in order to secure an important plant. In plant design, four or more all-steel tank filter plants have been put under construction or completed. Two of these are of the Morse design, developed by the designer for the Washington Suburban Sanitary District. Two consist of a cluster of connected but detached circular tanks serving as basins and filters. The success and economy of these plants presages considerable growth in this type of treatment plant construction.

One of the most notable amongst the water works betterments of the year has been the numerous and widespread installations of elevated tanks to add flexibility to system, produce pumping economies, enhance consumer service, or reduce fire rates. Outstanding in this quarter were the betterments at Buffalo, involving three tanks (2,000,000 gals. each) located at widely separated points on the fringes of the system, where both pressures and public relations were none too good.

Mr. Howson comments on the increasing use of "Transite" pipe and steel pipe protected by modern bituminous coatings, and the trend toward wider use of cement lined cast-iron pipes at but slight added cost. In respect to the little understood failure to more adequately appreciate established worth of cement lined pipe, Thomas F. Wiggins, New York Consulting Engineer, and long time advocate of cement linings, has only recently repeated his arguments in behalf of the non-tuberculating cement lined pipes.

Statistics reveal that a new high record was established for water works construction during last year, involving a total expenditure of $104,449,000. The more impressive is this fact when considering that there was a 17 per cent drop in contracts let on public works as a whole, when compared with 1936. Surprisingly, sewerage contracts in 1937 proved to be somewhat under those of 1936.

What is ahead for 1938? Those who live most closely to the matter predict that the cessation of Federal aid in financing, on top of the fact that 1937 saw an unprecedented volume of water works and sewerage construction, is to be responsible for a lean 1938 in new work in these two fields. This argument seems logical, but the curtailment will probably be surprisingly less than expected, because many of the Federal aid projects will carry over well through 1938. Furthermore, many municipalities counting on Government aid will consummate projects planned from ready money now available, due to the current ease of municipal financing at favorable interest rates. Others will follow the trends set by neighboring communities. Interesting are the reported contract figures for the first week of the new year, showing gains over the corresponding period in 1937—$805,000 being spent for water works and $2,224,000 for sewerage treatments. What's ahead for the balance of 1938? We will have to wait and see. It is not at all improbable that a reintroduction of Federal aid in public utility plant construction is to be witnessed.

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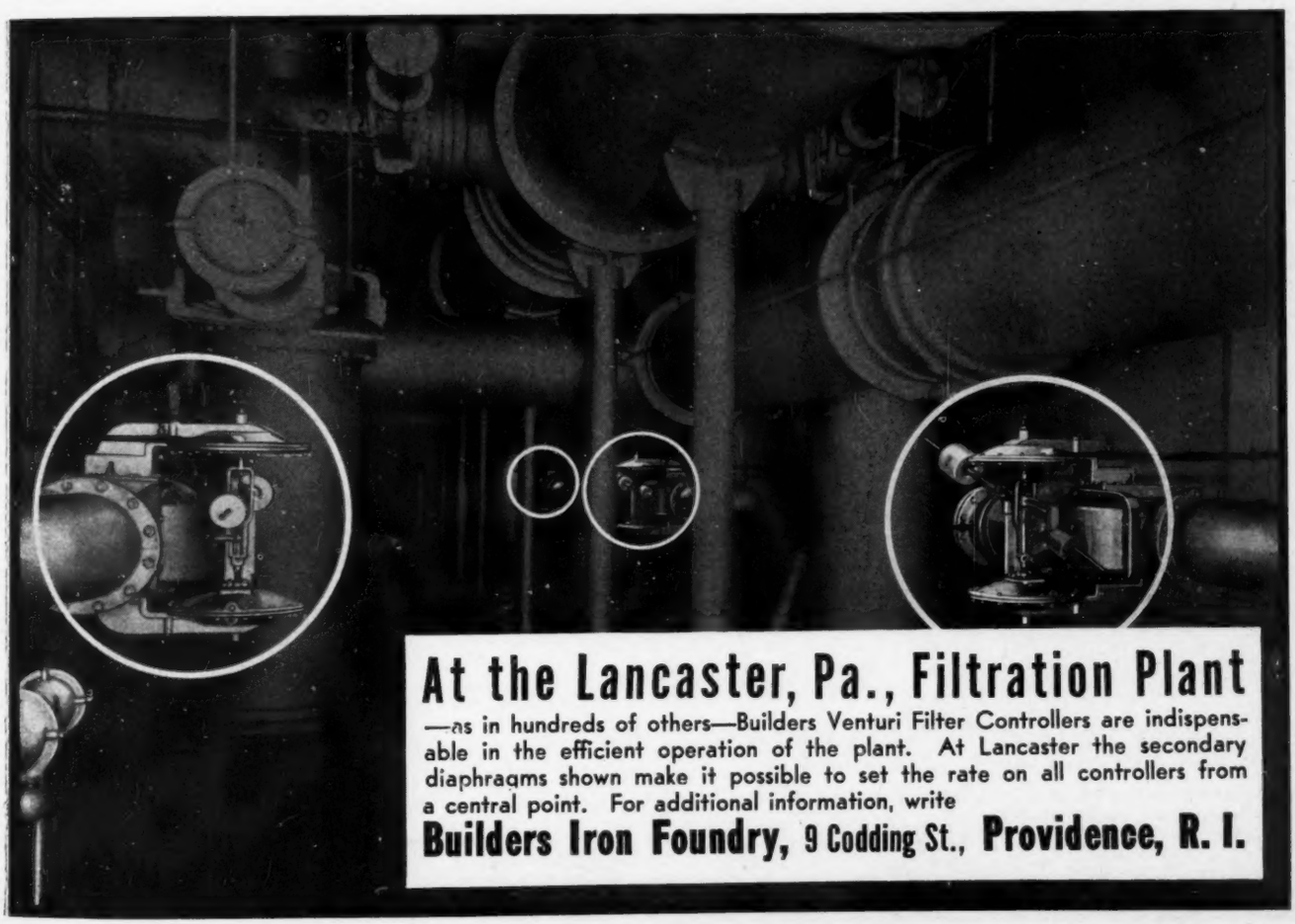
WELL WATER SYSTEMS



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—as in hundreds of others—Builders Venturi Filter Controllers are indispensable in the efficient operation of the plant. At Lancaster the secondary diaphragms shown make it possible to set the rate on all controllers from a central point. For additional information, write

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POMONA TURBINE PUMPS

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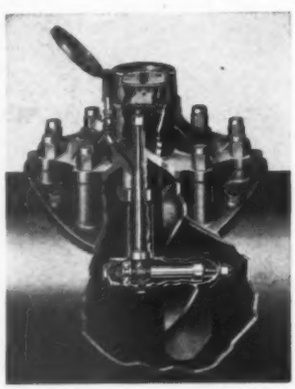
70,000,000 GALLONS IS A LOT OF WATER



Yet measuring that quantity is merely a day's task for a sixty-inch SPARLING Main-Line Meter. And it's built to stay on the job year after year with little attention or expense. Accurate, easily installed, economical.

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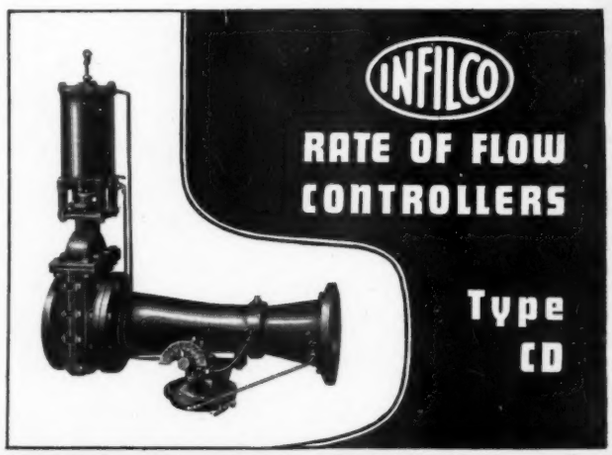


Accurate and Dependable

Infilco Type CD Rate of Flow Controllers have no extra gadgets to get out of order; no stuffing boxes, pivoted levers or cumbersome counterweights. Sensitive to even the most slight fluctuations in head.

Operating rates are controlled simply by turning a knob on the front of the rate setter. The design is simple and sensible. Designed to meet the demands of the most exacting water works engineers.

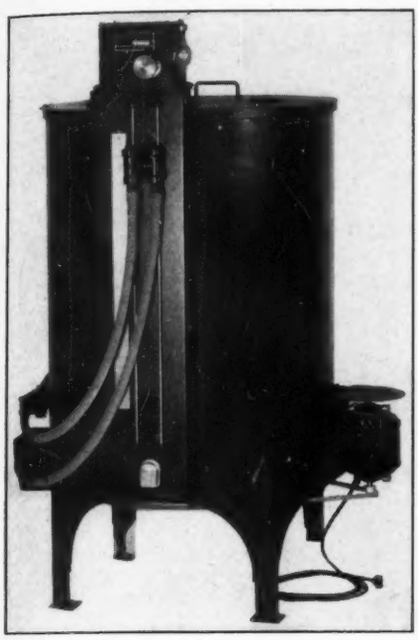
Write for Bulletin 500

INTERNATIONAL FILTER CO.
59 E. Van Buren Street, Chicago

EQUIPMENT NEWS

Improved Solution Feeder

Omega Machine Co., Kansas City, Mo., have recently announced an Improved Omega Solution Feeder, for feeding solutions or suspensions of materials such as activated carbon, "Black Alum" (carbon impregnated alum), lime, clays, "Ferrisul." The accompanying picture shows the improved feeder, equipped with an agitator for dissolving the chemical or keeping powders in uniform suspension.



Omega Special Precision Meter

The improved Omega Solution Feeder is adaptable to automatic feeding, such as is required in sludge conditioning with ferric chloride or other solutions. There are no valves or orifices to corrode or require adjustment; no moving parts within the liquid, other than the agitator. Can be operated by electric motor (larger sizes) or by spring motor (small sizes); provides visible feed and accuracy within 1% over a range of 1 to 100; is equipped with an empty tank alarm. The principle of operation is that of lowering the take-off (center top, of cut) at predetermined speed, to draw off the solution at required rates through rubber hose lines and hard rubber fittings—all on the *outside* of the solution chamber.

For literature better describing and price listing the improved feeder, address Omega Machine Co., 4010 Penn Ave., Kansas City, Mo.

▼

New Joint Compound Melting Furnace

A new joint Compound Melting Furnace is being offered by Hauck Manufacturing Co., of Brooklyn, N. Y., designed to evenly and quickly melt water main jointing compounds or bituminous compounds for sewer pipe. The new furnace is gasoline fired with a "soft" flame, a distinctive feature, to allow variable heating without spotty overheating. Featured, also, are the non-necessity for priming and pre-heating, making quick start a practical attainment. The fuel tank holds 4 gallons of gasoline; a single valve controls the flow to the burner, which operates as an ordinary domestic stove gas burner. To speed up the melt but at the same time preclude over-heating, such as is experienced with heavy cast-iron melting pots, a rapid heat-transfer steel pot of 8 gals. capacity (120 lbs. compound) is employed. Net weight of the furnace is only 118 lbs., with its built on wind-shield.

Compound melting pots, temporarily equipped with a copper coil, have been successfully used in pipe thawing operations, constituting simple ready-to-serve devices. Compressed air (or water) is run through the flash heating coil (substituted for the melt pot) which is connected to a line into the frozen main. The stream of hot air, or water, serves to bore through the ice cake; the flow of water thus started doing the rest. This "rapid fire," light weight, melting furnace would seem to be especially well adapted to such thawing procedure, in addition to its designed usage.

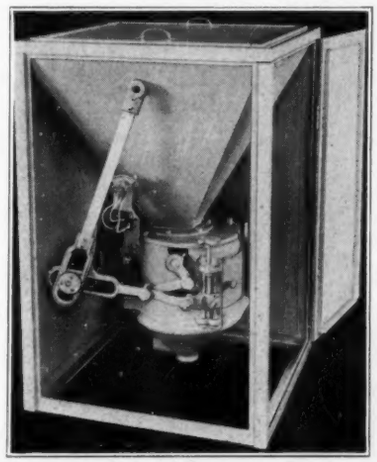
For descriptive literature on the Hauck Melting Furnace No. 37, write Hauck Manufacturing Company, 126 Tenth Street, Brooklyn, N. Y.

▼

Permutit's New Chemical Feeder

The "Dustproof" Dry Feeder, pictured here, is a new offering of The Permutit Company of New York City.

Featuring a minimum number of moving parts and dustproof construction, the feed mechanism involves the adaptation of a curved oscillating feed plate. Stroke variations, adjusted by a micrometer screw, vary the rate of feed, with accuracy from full machine capacity down to 2½ per cent of capacity—a feed ratio of 40 to 1, with accuracy assured.



New Chemical Feeder

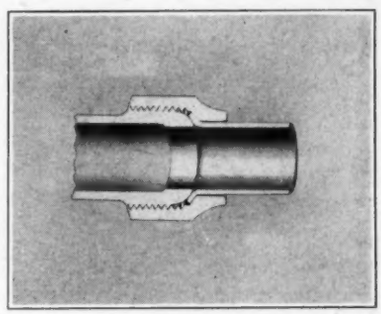
The feed plate is caused to oscillate by a system of levers, crank connected to a ⅛ H.P. dustproof gear-head motor. The feeder can be operated as a manually controlled or as an automatic feeder actuated by Venturi, orifice or rotating meters. Capacities *per hour* run from 16 to 450 lbs. of alum; 14 to 380 lbs. of hydrated lime or soda ash; 4 to 100 lbs. of powdered carbon.

For the new bulletin, "Permutit Dustproof Feeders," write The Permutit Co, 330 West 42nd St., New York City.

▼

Fittings for Flared Copper Tubing

Crane brass-fittings for flared copper tubing, discontinued a few years ago, have been reinstated as a regular line of Crane Co. products. These fittings (rated



at 175 lbs. water pressure) include elbows, bends, tees, couplings, reducers, adapters and flanging tools, in sizes ⅜ to 1¼ inch.

▼

Full Vision Masks

Something new in gas masks is the Full Vision Mask offered by Acme Protection Equipment Company of Pittsburgh, Pa. Obviously the outstanding feature is that of improved vision of the wearer—90 deg.

Hauck Melting Furnace

COPPERAS
(FERROUS SULPHATE)
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WATER TREATMENT

Summarizing the experiences with Chlorinated-Copperas in a large city another well-known and proficient manager* states in a published article* the following conclusions:

1—That it is an excellent cold water coagulant.

2—That it has reduced operating costs.

3—That it produces benefits, with no unfavorable results.

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(References to articles and authors' names available upon request)

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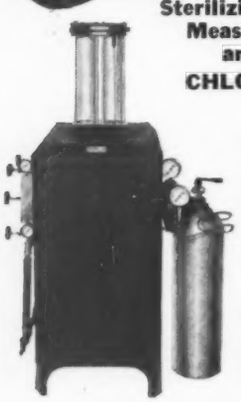
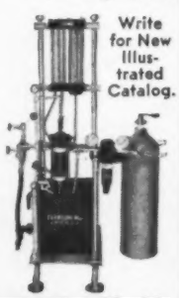


Accurate, Dependable, Safe! Finger tip control. All sizes with 1 to 10 capacity ratio —maximum 10 times minimum.

A complete line for Water Works, Sewage Plants and Swimming Pools with new Rota-Meter Gas Flow Control. New low prices all the way. Cabinet, Panel and Standard Models — so inexpensive that no job can afford to be without an extra "stand-by" unit.



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vertical and 120 deg. lateral. The large lenses are made of shatter-proof glass; the head harness is especially designed to eliminate all forehead pressure points; the all-rubber face-piece is fully moulded and curved to correct shape. Another feature is the one-way valve-flap ends on the air intake ducts, which close upon exhalation to preclude build-up of used (exhaled) air in the intake ducts. Cannisters are available for chlorine, ammonia, and other toxic or irritating gases or fumes, and smoke. The manufacturer also guarantees that the clear vision lenses will not fog up with use. The Acme bulletin "Full Vision Masks" describes the improved mask and appurtenances. For a copy write Acme Protection Equipment Co., Koppers Building, Pittsburgh, Pa.

▼

WITH THE MANUFACTURERS

From Birmingham to Burma Dresser's Couplings Are to Be Found

If we were writing a Dresser Coupling ad, this caption would probably be flashed across a double page spread. We thought that the order placed for Dresser Couplings for the sizeable Industrial Supply Line of Birmingham, Ala., would stand for sometime as Dresser's No. 1 Water Supply order. However, records are made for breaking, and news comes that the S. R. Dresser Mfg. Co. of Bradford, Pa., has just received an order for approximately 9,000 flexible couplings for the 45-mile-long water supply line to be constructed at Rangoon, Burma, India. The diameter of the steel pipe line (58⅞ in. O.D.) is something less than Birmingham's. We are advised that the pipe is to be manufactured by Stewarts and Lloyds of England, but the notice does not disclose the type of protective coatings to be employed.

▼

Frank Bachmann a Globe Trotter

Frank Bachmann, well-known Sanitary Engineer, who pioneered for The Dorr Co. in introducing Dorrco equipment into the water works and sewerage fields, and has long been in charge of Sanitary Sales for his company, has turned "globe-trotter." It's pretty soft for Frank to be able to do his "trotting" on company time and expense. He is now on a survey of sanitary engineering projects which takes him around the world. Before returning to his Chicago headquarters he will probably call in on E. B. Besselievre, in Buenos Aires, S. A., where he has been representing The Dorr Co. for sometime now. "Bess" was another pioneer in the sanitation field for his company.

▼

55 Miles of Fence Is a Lot of Fence for Water Supply Project

What is believed to be a record order for fence is that recently placed with the Anchor Post Fence Company, by the Metropolitan Water District of Southern California. To be used for fencing in of its reservoirs and open sections of the Colorado River Aqueduct, an order for 55 miles of six-foot chain link fence was placed at a cost of $188,000.

According to Wm. F. Brannan, president of the Anchor Post Fence Co., fabrication of this amount of fencing will require no less than 1,500 tons of steel. It will be manufactured at the company's Baltimore and Los Angeles plants, working double shifts in order to have the fence erected in place by May 1st, 1938.

▼

W. E. Wechter Receives Worthington Promotion

The appointment of Mr. W. E. Wechter as Manager of Oil and Gas Engine Sales, Atlantic Division, has been announced by Worthington Pump and Machinery Corporation. Mr. Wechter succeeds Mr. R. L. Howes, recently resigned.

W. E. Wechter

In his new duties, Mr. Wechter will supervise oil and gas engine sales in the Atlantic seaboard territory, in which are the Worthington offices at Boston, New York, Philadelphia, Washington and Atlanta. He will devote much of his attention to developing sales of Worthington Gas Engines in the sewage field.

Mr. Wechter will now make his headquarters at the Worthington office, 2 Park Ave., New York City.

▼

U. S. Pipe Staff Changes

D. B. Stokes, vice president of U. S. Pipe and Foundry Co., has announced the following changes in personnel of this company, effective January 1, 1938:

H. A. Hoffer, formerly Eastern sales manager, becomes assistant general sales manager, with headquarters at Burlington, N. J.

H. L. Nelson,* formerly Pittsburgh sales agent, has been made Eastern sales manager, Lincoln-Liberty Building, Philadelphia, Pa.

S. E. Linderman, formerly Washington representative, is now Pittsburgh sales agent, Koppers Building, Pittsburgh, Pa.

J. B. McFarland, of the Chicago sales office, has been appointed publicity representative, with headquarters at Burlington, N. J. He succeeds R. M. Shaw, Jr., who resigned to enter business for himself.

(*May be a coincidence, but every time a Central States Section member of A. W. W. A. gets elected a National Director, a better job takes him out of the territory. First Prof. Louis Carpenter; now it's Lloyd Nelson. A case of "Go East Young Man," in both instances.—Ed.)

KEEP ROOTS OUT of SEWERS with forever!

STOP ROOT Rings

U. S. PAT. No. 1,968,734

Insure your customers permanent satisfaction with sewer installations. Clay or concrete pipe sewers made ABSOLUTELY ROOT-PROOF by inexpensive Stop-Root Rings. Made of pure copper, the corrosion poisons and kills all roots. Stop-Root Rings are installed without tools or special equipment by "common labor". Joints are made in the regular way.

GUARANTEED 10 YEARS

We will furnish a written 10-year guaranty against root trouble, backed by a national insurance company. The protection of Stop-Root Rings, however, will outlast the sewer.

WRITE for free and complete data for your files.

A-B-C MFG. CO. 205 S. 4th St. **Quincy, Illinois**

You can prevent wear and cutting of rods, plungers, shafts and valve stems by using

MABBS RAWHIDE PACKING

In Your Water Works and Sewage Plants

Trade Mark

Reg. U. S. Pat. Off.

IT LASTS LONGER

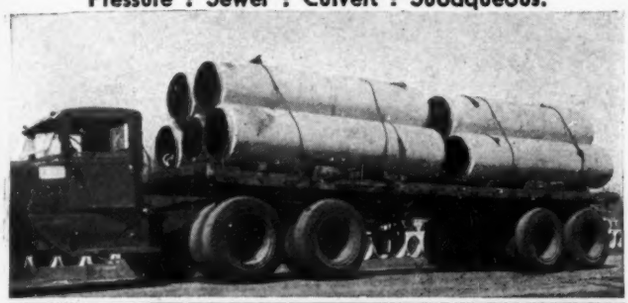
Is Anti-Frictional, Saves Power, Labor and Repairs. Will prove the cheapest packing that can be bought.

We make a specialty of Rawhide Meter Washers.

MABBS HYDRAULIC PACKING COMPANY

431 S. Dearborn St. Incorporated 1892 Chicago, Illinois, U.S.A.

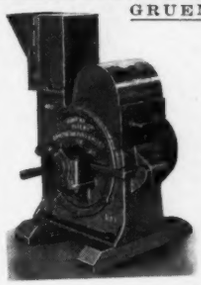
Pressure : Sewer : Culvert : Subaqueous.



LOCK JOINT REINFORCED CONCRETE PIPE

LOCK JOINT PIPE CO. Est. 1905. Ampere, N. J.

GRUENDLER — ESTABLISHED 1885



SEWAGE SCREENING SHREDDERS

Gruendler's Ball Bearing Trouble Free Sewage Shredders — Uniformly handles Sludge and Screenings so that 100% passes bar screen—eliminates trouble at Ball Valve and through system. Write for Information.

Gruendler's Garbage Shredders

(Built in any capacity.)
Prepares Garbage and Rubbish for Incinerator or for Fuel

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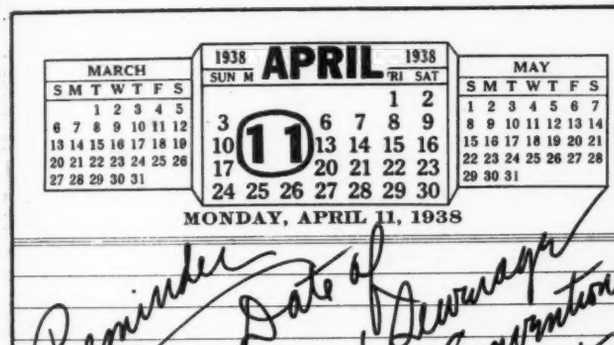

THE **NATIONAL** METHOD OF **WATER MAIN CLEANING**

WRITE FOR BOOKLET "The cleaning of water mains"

30 YEARS Experience

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***The* FORD COPPERHORN**

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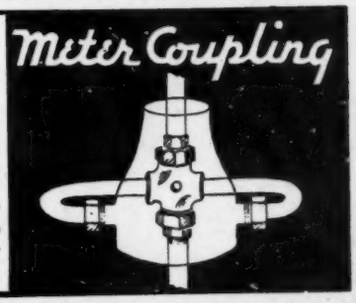

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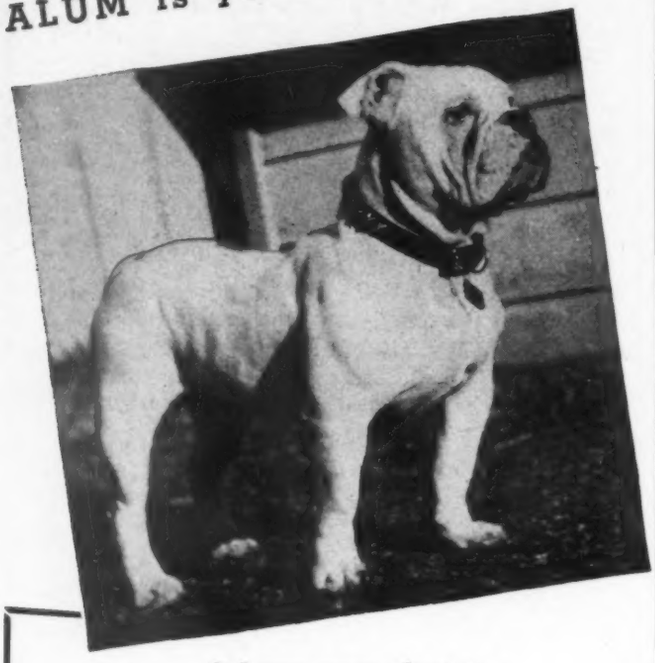

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MEETINGS SCHEDULED:

Jan. 19-21—NEW YORK CITY, N. Y. (Engineering Societies Building).
American Society of Civil Engineers. Sec'y, Geo. T. Seabury, 33 West 39th St., New York City.

Jan. 20*—BOSTON, MASS. (Statler Hotel).
New England Water Works Assn. (Monthly Meeting). Sec'y, Frank J. Gifford, 613 Statler Bldg., Boston, Mass.
*(Other scheduled meeting Feb. 17 and March 17th.)

Jan. 20-22—NEW YORK CITY (Hotel McAlpin).
New York State Sewage Works Assn. (Annual Meeting). Sec'y, A. S. Bedell, State Dept. Health, Albany, N. Y.

Jan. 24—NEW BRUNSWICK, N. J. (Rutgers University).
New Jersey Water Works Short Course (Jan. 24th-Feb. 5th).

Feb. 14—NEW BRUNSWICK, N. J. (Rutgers University).
New Jersey Sewage Works Short Court (Feb. 14th-26th). Prof. H. N. Lendall, Director of Short Schools, College of Engineering, Rutgers University.

Feb. 14-19—COLLEGE STATION, TEX. (A. & M. College).
Texas Water Works Short School. Sec'y, V. M. Ehlers, State Dept. Health, Austin, Texas. Director, Prof. E. W. Steel, A. & M. College.

Feb. 15—NEW BRUNSWICK, N. J. (Rutgers University).
New Jersey Section A.W.W.A. Sec'y, Prof. H. N. Lendall, Rutgers University, New Brunswick, N. J.

Mar. 10-11—TRENTON, N. J. (Stacy-Trent Hotel).
New Jersey Sewage Works Association. Sec'y, John R. Downes, Bound Brook, N. J.

Mar. 17-18—JAMESTOWN, N. Y. (Hotel Jamestown).
New York Section A.W.W.A. Sec'y, R. K. Blanchard, 50 West 50th St., New York City.

Mar. 21-23—LOUISVILLE, KY. (Brown Hotel).
Kentucky-Tenn. Section A.W.W.A. Sec'y, H. D. Schmidt, State Dept. Health, Nashville, Tenn.

Mar. 23-25—WINDSOR, ONTARIO (Prince Edward Hotel).
Canadian Section A.W.W.A. (Annual Meeting). Sec'y-Treas., A. E. Berry, Ontario Dept. Health, Parliament Bldgs., Toronto, Ont.

Apr.5-6—(Place not announced.)
Illinois Section A.W.W.A. Sec'y, Mr. Winfred D. Gerber, P. O. Box 232, Urbana, Ill.

Apr. 7-8—LAFAYETTE, IND. (Purdue University).
Indiana Section A.W.W.A. (Annual Meeting). Sec'y-Treas., John A. Bruhn, Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.

Apr. (Date open.)—(Place not announced.)
Kansas Water and Sewage Works Assn. Sec'y-Treas., Earnest Boyce, State Board of Health, Lawrence, Kan.

Apr. 24-28—NEW ORLEANS, LA. (Hotel Roosevelt).
American Water Works Association (Annual Convention). Executive-Secretary, H. E. Jordan, 29 West 39th St., New York City, N. Y.

May 11-12—BOZEMAN, MONT. (State College).
Montana School for Water Works Operators. Sec'y-Treas., H. B. Foote, Director, Div. of Water and Sewage, State Board of Health, Helena, Mont.

May 13-14—BOZEMAN, MONT. (Baxter Hotel).
Montana Section A.W.W.A. Sec'y, H. B. Foote, State Board of Health, Helena, Mont.

May 19-21—SPOKANE, WASH. (Hotel Davenport).
Pacific Northwest Section A.W.W.A. Sec'y, Fred Merryfield, Oregon State College, Corvallis, Ore.

May 23-25—DAYTONA BEACH, FLA. (Hotel not announced).
Florida Section A.W.W.A. Sec'y, J. R. Hoy, 404 Hildebrandt Bldg., Jacksonville, Fla.

May 25—NEW MILFORD, N. J. (Hackensack Water Co. Plant).
New Jersey Section A.W.W.A. Sec'y, Prof. H. N. Lendall, College of Engineering, Rutgers University, New Brunswick, N. J.

June 3-5—BUFFALO, N. Y. (Hotel Lafayette).
New York State Sewage Works Assn. Sec'y-Treas., A. S. Bedell, State Board of Health, Albany, N. Y.

CATALOGS AND LITERATURE RECEIVED

[Any of the publications reviewed in this section can be secured from or through Water Works and Sewerage, if such be desirable.]

"Pipe Line Facts"—"No subject in the water works field has received more attention recently than pipe linings and coatings," is the foreword of a new booklet just issued by T. A. Gillespie Co. of New York City. In a very condensed manner the booklet recites facts and opinions of leading engineers and operators concerning the need for more prevalent lining of iron and steel water pipe and, as far as practicable, mains already in use. The booklet is literally a review of the subject, made up of brief paragraphs taken from published committee reports and articles, authorship and source of the quotation being shown. Then follows, in summarized form, 10 reasons why reconditioning of existing mains and lining in place with dense non-corrodible cement mortar, centrifugally applied by the Gillespie method, has been recently undertaken by the company. The method is briefly described and the machine illustrated. Here is an excellent digest of the question, "To Line; or Not to Line" in very readable form. For a copy of "Pipe Line Facts" write T. A. Gillespie Co., 7 Dey St., New York City.

"Something New In Metering"—Is the Kennison Open Flow Nozzle, designed for measuring water and sewage flows by Karl R. Kennison, Engr., Boston Metropolitan Water District. It is illustrated and described in a new bulletin just published by Builders Iron Foundry. Features, making it especially interesting as a unit for measuring sewage and sludge flows, is its simplicity of design, self-scouring ability and freedom from clogging by large solids, rags, etc. Then, there is the large changes in head (float movement on the indicator and recorder instrument), at extremely low head loss, for equal flow increments over a wide operating range, down to extremely low rates. In diameters from 6 to 36 inches (inlet) capacities are 253,300 g.p.d. to 18.29 m.g.d. The new unit is recommended for metering flows through partially filled pipes or open channels. For a copy of Bul. 289, write Builders Iron Foundry, Providence, R. I.

"Weather Instruments—by Friez"—is a truly remarkable production, designed to make the reader wish to find a spot somewhere for a Friez Weather Instrument and Recorder—particularly the distinguished Patrician Models—although he may not genuinely need such. Done in blue, silver and ivory with "Wire-O" Binding, cellophane plated covers, and the best of paper stock and engraving and printing, Friez's 1938 Catalog No. 6 is a work of art. Aside from this, it contains the full illustrated line of meteorological instruments for securing and recording, wind direction and velocities; precipitation and evaporation; humidity and temperatures; water levels and flows; remote indicators and recorders; temperature and humidity control devices; air conditioning controllers et al. In the form of a replaceable appendix, is the index and helpful current price lists. Much of the Friez line will interest engineers and operators in the water works and sewerage fields—especially so the wind and temperature and humidity instruments, for sewage plants subject to odor complaints. For Catalog No. 6 write Julien P. Friez & Sons, Baltimore, Md.

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"Speed Control in Sewage Works"—Is discussed in a booklet from Reeves Pulley Co. of Columbus, Ind. It is essentially a reprint of a paper on "Uses and Applications of Variable Speed Control in Sewage Works," presented by H. B. Diehl before the N. Y. State Sewage Works Assn. In this day of increasing mechanization of water and sewage treatment plants, speed control mechanisms are finding several important uses and new ones appear constantly. Many are cited in the booklet which can be had from Reeves Pulley Co., Columbus, Ind.

"How to Select and Use Wrenches"—Is an interesting and enlightening little booklet in which J. H. Williams & Co.—"The Wrench People"—tell the reader a great deal about wrenches, the proper wrench selection, how to use wrenches in various operations. This little booklet is well worth having as a real wrench-guide and the full line of Williams' wrenches, for every purpose and pocketbook, are illustrated and described. Included are the safety "non-sparking" wrenches, and alloy "Super-wrenches." For this helpful booklet write J. H. Williams & Co., 76 Spring Street, New York City.

"Victor Propeller Pumps"—Is a recent bulletin from the Kimball-Krogh Pump Division of Victor Equipment Co. of Los Angeles and San Francisco. Available in 8 sizes the Victor Propeller Pump is especially adapted for low head pumping where large capacities are required. The features are the trouble free operation, the Oilite water lubricated bearings, and the readily adjustable blade-pitch impellers, with blades subject to locking at the proper degree of pitch to secure maximum efficiencies under a wide range of operating conditions. For Bul. No. 700 write Victor Equipment Co., San Francisco and Los Angeles.

"Hill-McCanna Products—Are described and illustrated in a special bulletin devoted to the well known Saunders Streamline Valves, with corrosion proof diaphragm, proven and especially serviceable on chemicals lines; to Chemical Proportioning Pumps in four distinctive models and 400 sizes; to the especially well known Hills-McCanna Force-Feed Lubricators for economically but safely oiling all classes of equipment; Acid Proof Centrifugal Pumps for chemical solutions; and, bronze and special alloy castings. For reference is a useful bulletin; for details, separate bulletins are available on each of the items. For "Hill-McCanna Products" write Hills-McCanna Co., 2349-59 Nelson St., Chicago.

"A New pH Recorder—With Glass Electrode"—The Cameron Glass Electrode pH Recorder is announced in a bulletin from Wilkins Anderson Co., Chicago distributors of "Waco" laboratory equipment and supplies. Featuring the sturdy dependable glass ectrode, the Cameron pH Meter has been developed to produce chart records automatically, and at remote points. Adaptation of the glass-electrode is novel in pH recording devices and is being featured after two years of proven service in measuring pH over the entire acid and alkaline ranges, in turbid, colored, oxidizing or reducing liquids and vapors. The Cameron recording unit is especially neat, compact, and is designed with the minimum number of moving parts. The potentiometric circuit is kept standardized automatically. The new recorder can be connected to a "Controller" to operate valves or chemical feeders, to secure pH control automatically—such as in water processing and sewage sludge conditioning. For a copy of "The Cameron pH Recorder," write Wilkins-Anderson Co., 111 N. Canal St., Chicago, Ill.

"F-M Vertical Motors"—Are described in a new bulletin from Fairbanks, Morse & Co., which sets forth the features of F. M. hollow shaft motors, for deep well turbines; also, solid shaft motors for vertical centrifugal pumps. Features of the hollow shaft motor for deep well pumping are: ease of installation, compactness, assured permanent shaft alignment, weather proof construction, and high thrust load capacity. The entire load on the pump shaft, including weight of shaft, pump and thrust load of the water column (being lifted) is carried on the easy-to-service bearing on the top of the motor. The solid shaft motors carry the major load on thrust bearings beneath the motor, the motor bearings carrying only the weight of the rotating parts of the motor. Another feature listed for the hollow-shaft motor is the safety-clutch which automatically disengages motor shaft from pump shaft should the direction of rotation of motor reverse, due to power failure or change in phase relation. For Bul. 1410, write Fairbanks, Morse & Company, 900 South Wabash Ave., Chicago.

"Automatic Pump Control With the New Floatrol"—From Automatic Control Co. has come a folder announcing the new Type S "Floatrol," for use in sequence control of one or two or three pumps, served by a single suction well or discharging into the same tank or reservoir. Featured as distinctive, is the corrosion resistant construction, involving a ceramic float on stainless steel tape, aluminum housing and stainless steel shafting, armored steel mercury switches. It states "3 Good Reasons for Selecting Floatrol" to be the three Costs—installation, maintenance and first cost. For the bulletin "Type S. Floatrol" write Automatic Control Co., 2590 University Ave., St. Paul, Minn.

"LEAD"—Is the name of the magazine being resumed by The Lead Industries Association. The January number contains some interesting stories and illustrations of applications of roofing lead, lead pipe, lead paints. One especially interesting story describes the 56 miles of pneumatic mail transport lines, which connect New York's many branch post offices with the main post office. They are constructed of machine bored B & S cast-iron pipes, jointed with calked lead for aid-tightness. The mail, in hollow tube projectiles, is shot through the cast-iron lines by air pressures requiring smooth bore, and air-tight joints. If you wish to receive "LEAD"—as a free magazine—merely write Lead Industries Assn., 420 Lexington Ave., New York City.

"Limitorque Valve Control"—Is the title of a copiously illustrated 48 page brochure from Philadelphia Gear Works. It describes the functioning of the Limitorque mechanism for controlling the opening and closing of large valves, without torque-strain, and precluding breakage or jamming of valve parts, bent stems, damaged threads, etc. Many applications of the hand, air and motor operated "Limitorque" Control Mechanisms, with its torque-limit switch, are pictured together with actual plant installations. Complete specifications appear, and then a list of installations. For a copy of "Limitorque Control," write Philadelphia Gear Works, "G" Street and Erie Ave., Phila., Pa.

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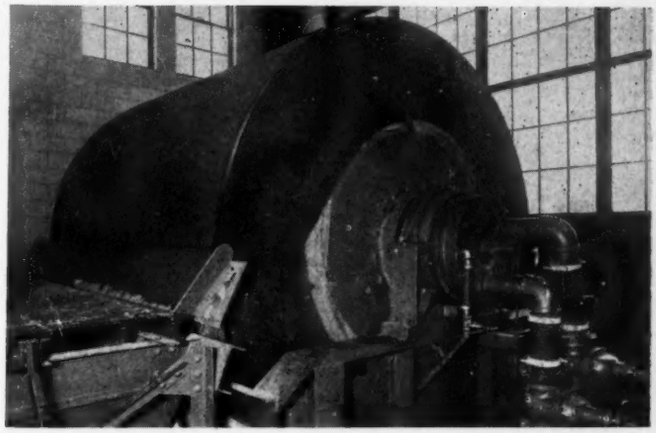

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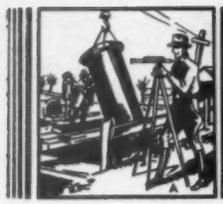

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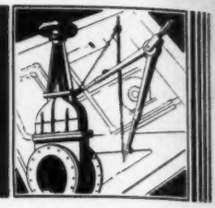

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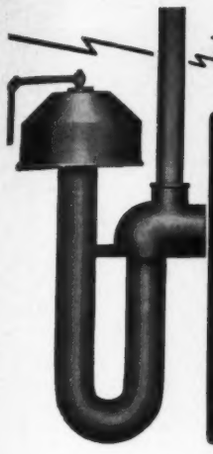

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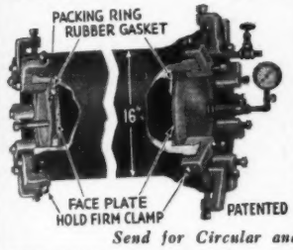

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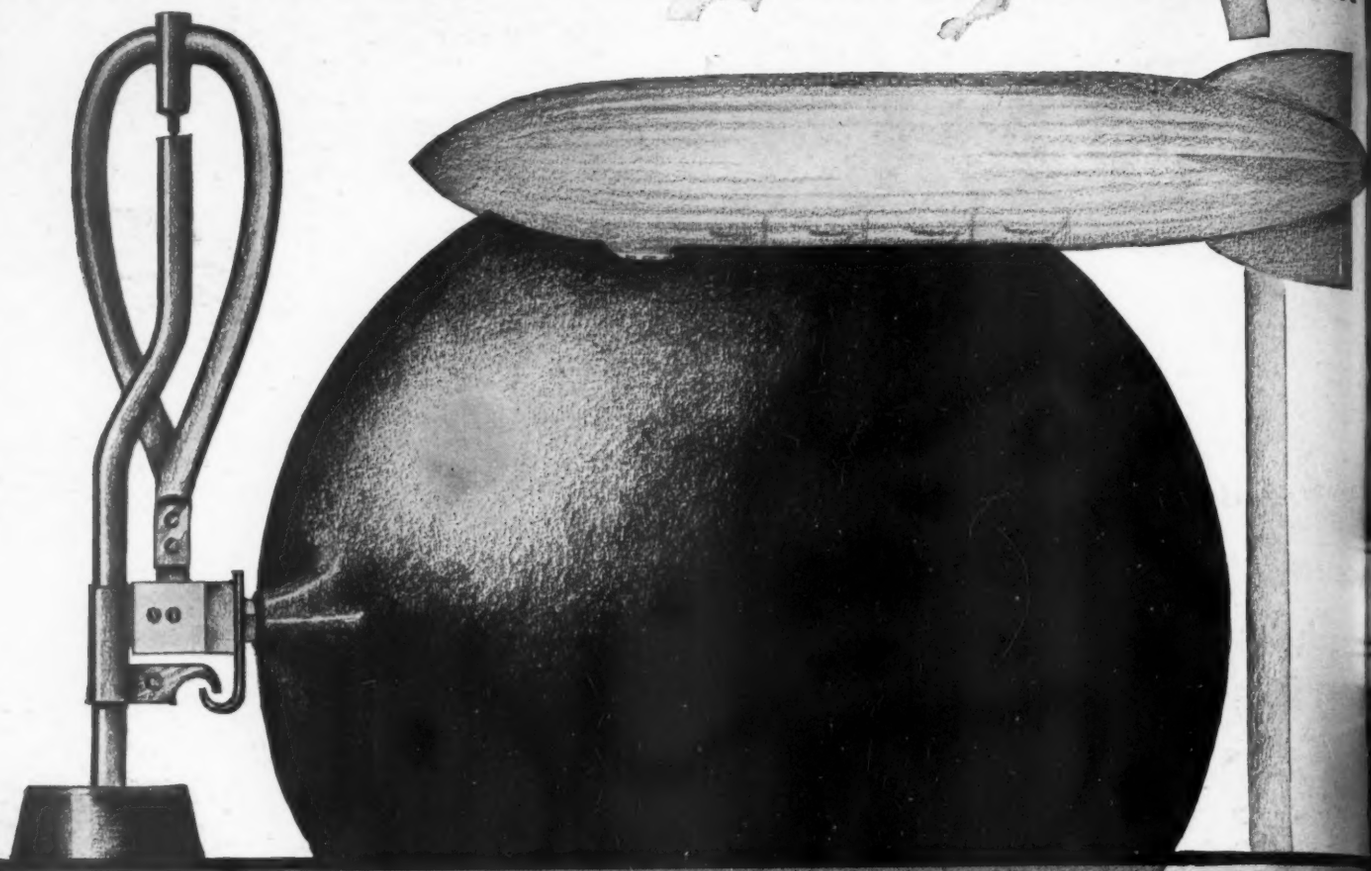

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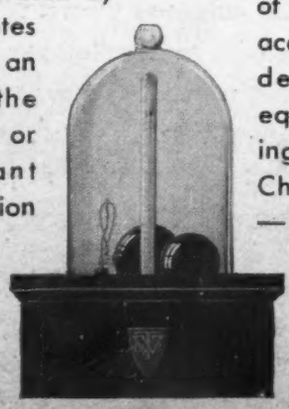

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